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New London Harbor Improvement Project

The State of Connecticut Begins Erection of Large Steamship Pier at New London—Novel Type of Construction Adopted

BY WILLIAM T. DONNELLY *

In September, 1912, the writer was retained as consulting engineer to the Rivers, Harbors and Bridges Commission of the State of Connecticut, with particular reference to a project for the improvement of New London harbor, to be carried out by and at the expense of the State of Connecticut. The commission as originally constituted consisted of Edward H. Warner, Hartford, chairman; Frank V. Chappell, New London, secretary; Oliver Gildersleeve, Portland; Thomas F. Noone, Rockville, and William H. Cadwell, New Britain. The organization was completed in the fall of 1912 by the appointment of Mr. Waldo E. Clarke as resident engineer, and a preliminary investigation was at once commenced to determine the general lines and location of the improvement, which was to consist, primarily, in one or more piers with the best possible arrangement of rail and water access.

After a careful survey and consideration of the entire harbor and water front it became apparent that the most advantageous location for the improvement would be at the head of the harbor alongside and to the eastward of the Central Vermont pier. This location as regards accessibility by rail and ship is practically ideal. It will be noticed by reference to the plan that ships entering New London harbor and sailing directly up the main channel can enter and dock at either side of this pier with but a slight change of course in the entire distance, and that the pier has direct connection with both the Central Vermont Railroad, which is the Southern New England connection of the Grank Trunk system of Canada, whose main line to the Pacific is soon to be completed, and the New York, New Haven & Hartford Railroad, with its extensive connections with the Pennsylvania and other railroad systems of the United States.

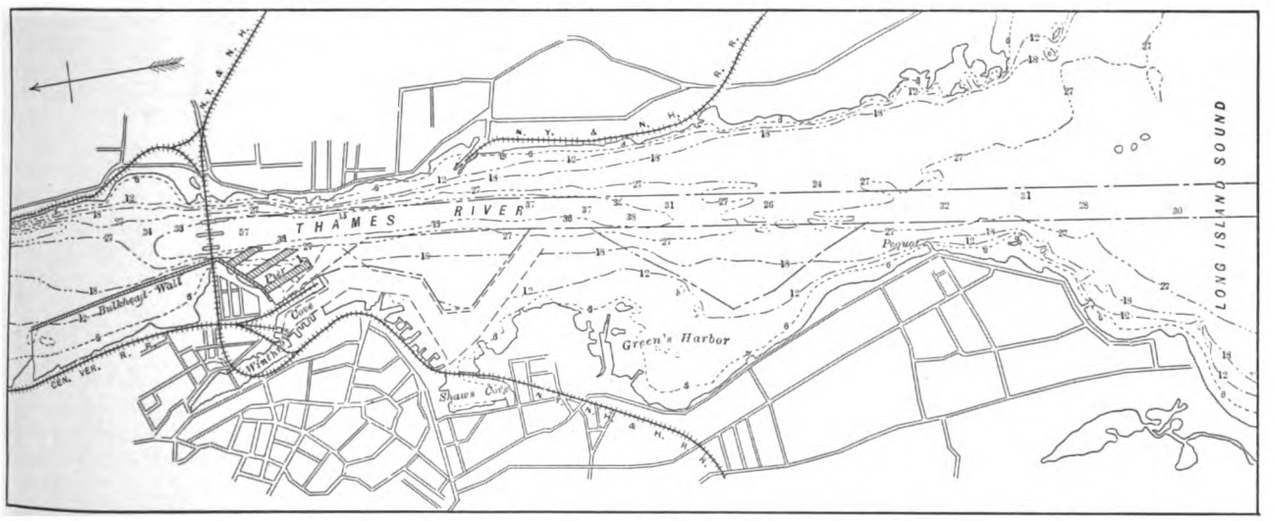

Fig. 1.—Plan of New London Harbor, Showing Location of New Pier and 35-Foot Channel

New London harbor is one of the best and most easily entered harbors on the United States coast. As a matter of fact, New London owes its name to the anticipation and hope of the early settlers that it was to rival the city of the same name with which they were so familiar, and it is still possible that this city in the future may be an important commercial gateway to the heart of New England and to Canada on the north.

As soon as this determination as to location had been reached, thorough and careful preliminary borings and surveys were carried out to determine the actual outline and location, with the general results as shown in the harbor plan, Fig. 1.

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In general agreement with the recently-accepted standard of 1,000 feet as a practical working length of the larger class of ocean steamers, this length was decided upon for the first pier. Much consideration was given to the desirable width of pier, and careful investigation and comparison was made with similar work undertaken by the State of Massachusetts in Boston harbor, the city of Montreal in Canada, and also with extended developments in New York harbor, San Francisco, Cal., and Seattle, Wash. This resulted in placing the maximum desirable width at 200 feet.

at a very reasonable cost. The third consideration was the very limited area of level land for warehouse facilities and approach.

All these considerations directed towards the design as worked out; that is, the central portion of the pier, 100 feet wide, enclosed by a rubble masonry retaining wall carried on piling cut off at the low-water line; the space between these walls to be filled with the dredged material from the slip on either side of the pier; a shelf or wharf of creosoted piling, 50 feet wide, to be constructed on either side, making a total

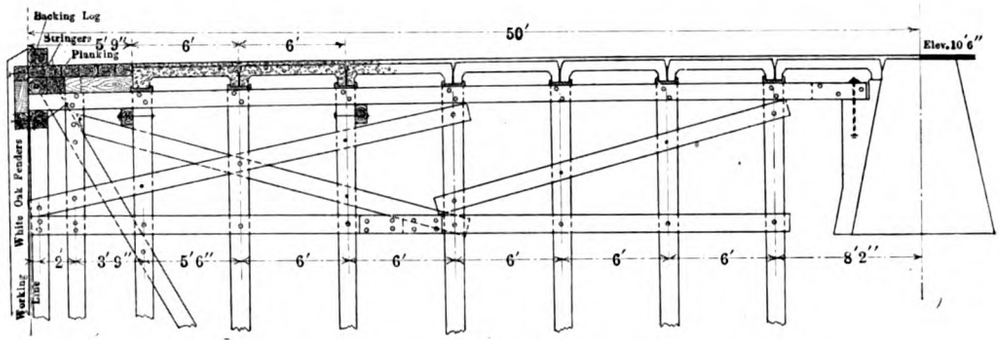

Fig. 2.—Section Through Wharf at Side of Central or Permanent Pier

In developing the particular method of construction to be used, a series of studies was made in complete detail by the resident engineer and his staff as follows:

First. The method of supporting the entire pier on steel caissons on approximately 20-foot centers, excavated and filled with concrete, with a deck of reinforced concrete and steel.

Second. A somewhat similar construction with concrete piles.

Third. A creosoted pile construction with timber caps and stringers and concrete decking with asphalt top, similar to recent developments for New York harbor piers.

Fourth. The final and accepted method as shown on general plan, Fig. 3.

This final method was the outcome, as most plans are, of certain controlling local conditions. The bottom where the pier was to be located, while of excellent material, contained occasional boulders, which would make the sinking of caissons uncertain and expensive. Another local condition was the possibility of obtaining stone for rip-rap in the vicinity

width of 200 feet; the piling to be braced and capped in practical conformity to the standard worked out in relation to pier work of New York harbor, and the slope from the foot of the retaining wall to a depth of 35 feet at low water, to be protected by rip-rap placed after the piles were driven.

In connection with the decking very careful and extended studies were made by the resident engineer to determine the best and most economic form and method of construction. This has resulted in the adoption of a block pre-molded section of concrete, carefully reinforced with steel, to carry a working load of 600 pounds per square foot. The detail construction of these blocks and the method of laying them are shown in Figs. 2, 3, 4 and 5. Reference to Fig. 2 shows that they are carried on cast iron shoes resting on the top of the piles, and it will be understood that the finished blocks or slabs will be placed upon these shoes, wedged up to a level and grouted to obtain a satisfactory bearing, after which 2 inches of asphalt paving will be laid on top. This has been found to make a very much better wearing and work-

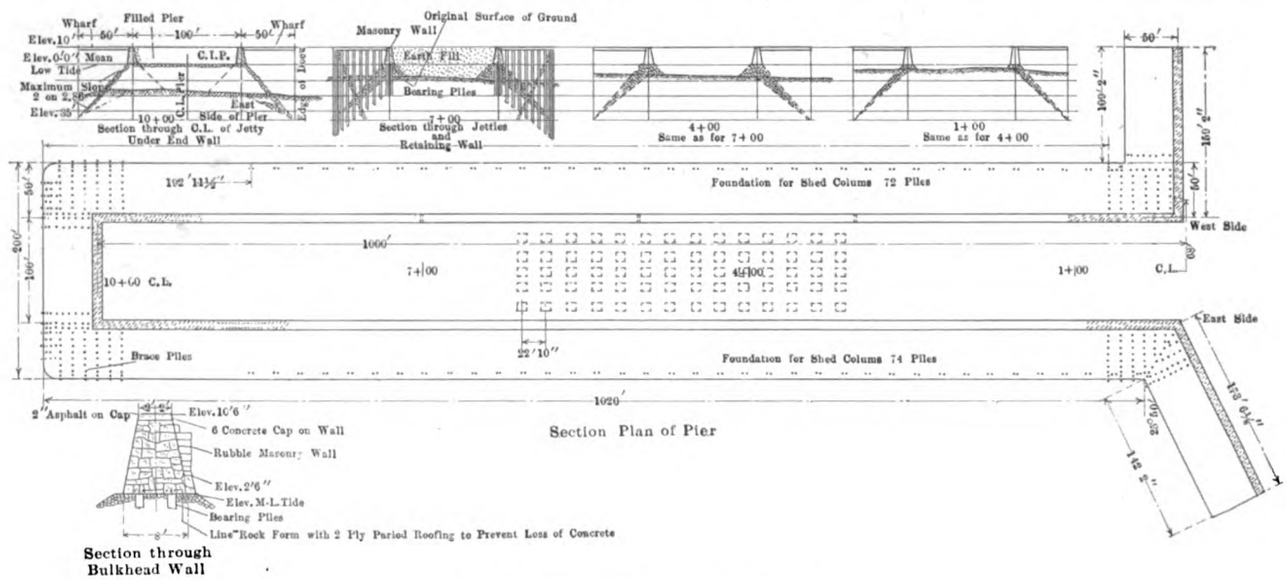

Fig. 3.—General Plan of the New Dock

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ing surface for piers than concrete, which is apt to become wet and sloppy, and is complained of by workmen as being cold and disagreeable under foot.

To provide a yielding cushion for the contact of ships at the edge of the pier, the outer 6 feet is covered with 8-inch

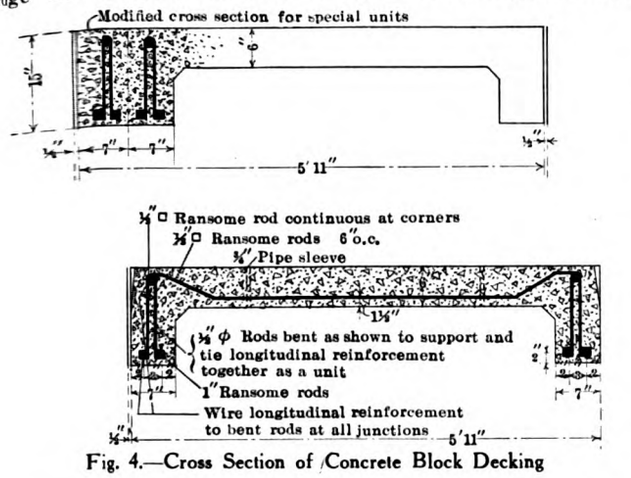
Modified cross section for special units
5' 11"
Ransome rod continuous at corners
Ransome rods 6' o.c.
Pipe sleeve
Rods bent as shown to support and tie longitudinal reinforcement together as a unit
Ransome rods
Wire longitudinal reinforcement to bent rods at all junctions
5' 11"

Fig. 4.—Cross Section of Concrete Block Decking

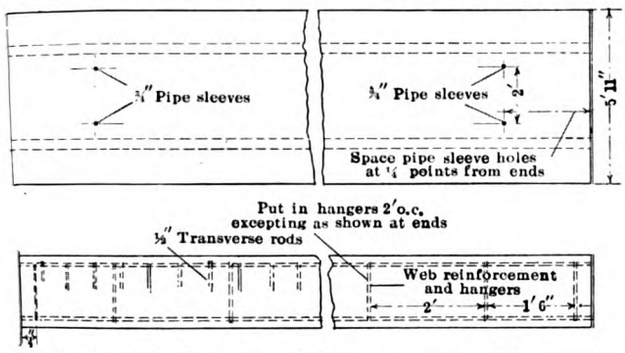
Pipe sleeves
Pipe sleeves
Space pipe sleeve holes at ¼ points from ends
Put in hangers 2' o.c. excepting as shown at ends
Transverse rods
Web reinforcement and hangers
2'
1' 6"

Fig. 5.—Longitudinal Section of Concrete Block. The Length Varies From 6 to 24 Feet

yellow pine planking and a system of oak fenders and bracing worked in along the outer edge. Arrangement has been made for double railroad track down the center of the pier in a depression, bringing the floor of the cars on a level with the deck of the pier and with provision for frequent bridging when cars are absent.

In working out this general design it was the intention to make the central portion of permanent construction, and eventually to build a fireproof warehouse upon part or the whole of the central part with large elevators and other approved appliances for handling package freight to and from ships. The pile construction of the pier on each side is considered to be only semi-permanent, and this attitude has been deliberately taken, as, after careful consideration, it was agreed that a permanent structure could easily have a structural life exceeding its commercial or useful life. An illustration showing the wisdom of this course is found in the case of a railroad bridge over the Thames River adjoining this property. The bridge is just twenty-five years old. It is in excellent condition and capable of use for many years to come, but it has outlived its commercial life, and at the present time plans are being made for the construction of a bridge to meet the present needs, which the old bridge will no longer fulfill. In the case of the new pier, it is considered that the creosoted piling, yellow pine clamps and braces and concrete block decking, which can be easily removed to replace a deteriorated pile or brace, will have a life of at least twenty-five years, which is considered to be the commercial life that should be considered for the arrangement and design of this pier.

Relative to placing a warehouse on the central portion of the pier for the storage of goods to and from ships, it is considered that this will in every way tend to rapidity of despatch in both receiving and delivering cargo, which is the first consideration in the arrangement of the connecting link between water and land transportation. This becomes a paramount consideration when it is clearly and fully understood that the financial return from transportation comes wholly or solely from moving the material from one place to another.

By referring to the plan of the harbor, Fig. 1, it will be seen that the general plans of the Harbor Commission contemplated two additional piers, and the bulkheading and creating of a considerable additional area of level land above the bridge from dredged material incidental to the dredging of a 35-foot channel for New London harbor. The manner of this general development of the harbor has been worked out in connection with the representatives of the United States Government, who have shown every desire to encourage and assist in the undertaking.

At the present time the contract for the pier up to the deck, including all foundations and the dredging of the slips on either side, has been let the T. A. Scott Company, of New London, Conn., and the work is being pushed as rapidly as possible.

Since the formation of the commission, Edward H. Warner, chairman, has resigned, and Thomas F. Noone, of Rockville, has been made chairman. The vacancy caused by the death of Oliver Gildersleeve has been filled by H. H. Hamilton, of Bridgeport. Valuable aid to the commission has been rendered by Governor Simeon E. Baldwin and Bryan F. Mahan, Mayor of New London.

Inclined Elevators for Economical Handling of Freight

In a recent lecture on the cost of handling freight at terminals, Secretary Redfield is quoted as making the statement that "It costs as much to load a barrel into a car at Chicago and to unload it at New York as it does to move the barrel

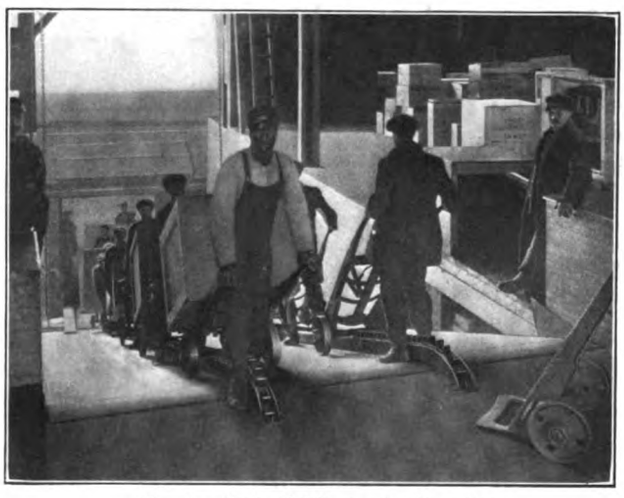

Fig. 1.—Inclined Elevator in Operation

between the two cities on the railroad." The railroad and the steamship lines are now face to face with this problem. The cost of handling freight by hand trucking, which is now almost universal at freight terminals, is out of all proportion to the charge by the transportation companies for carrying the freight. The cost of handling miscellaneous package freight is frequently 35 cents (1s. 5½d.) per ton at the terminal, and in some locations 70 cents (2s. 11d.) a ton would be nearer the amount.

A large proportion of the freight-handling charge is due

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to the high cost and scarcity of labor available for this purpose. This is a condition that is not likely to improve, as it is becoming more and more difficult to find men suitable for this work. It therefore becomes necessary to devise some plan which will make it possible to do the laborious part of the handling by mechanical means and use the men to supply the needed intelligence to transfer a package of freight from one location to another.

The ordinary two-wheel hand truck, which can be placed under the package, bale, barrel or box with the least amount of labor, has been found, generally speaking, most satisfactory within certain limits. When it is necessary, however, to transport a loaded truck up an incline or for a considerable distance on a level, the man and the truck become inefficient and expensive.

The machines illustrated, known as inclined elevators, have been designed to eliminate the laborious part of manual trucking in handling miscellaneous freight, and in some cases where they have been installed the speed of freight handling has been accelerated 20 percent.

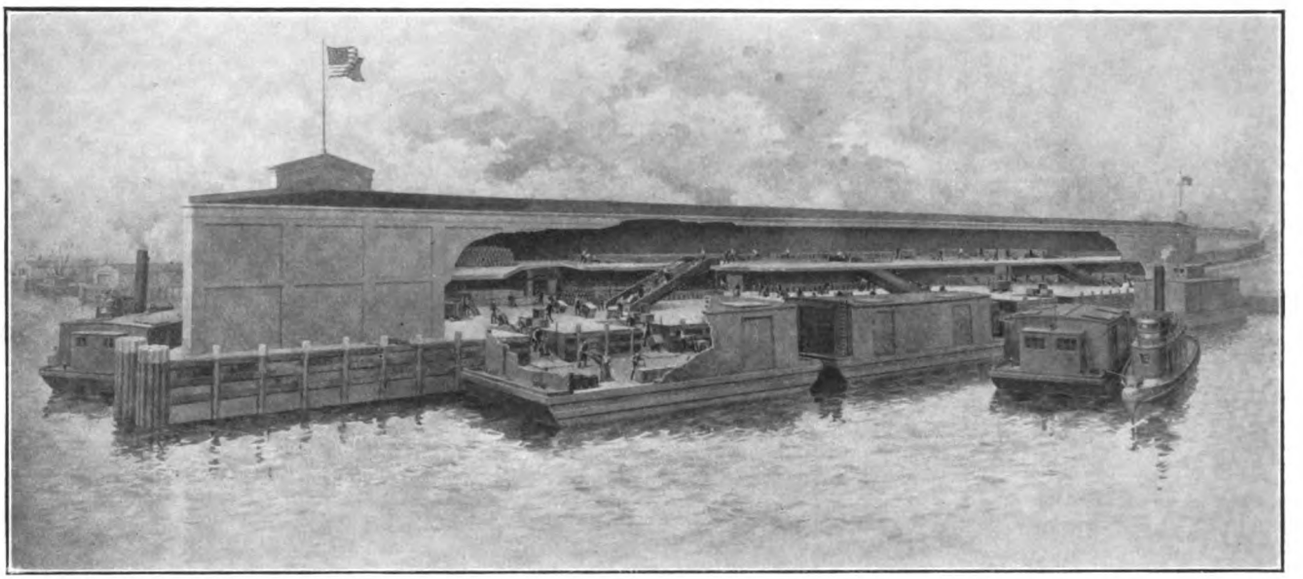

Fig. 2.—Installation of Inclined Elevators at the Mystic Dock of the Boston & Maine R. R. at East Boston, Mass.

The unloading of freight from a ship requires the employment of a large number of men, and any apparatus which will produce more rapid movement or acceleration will show a corresponding saving in dollars and cents. This saving in some cases where these machines have been installed has amounted to a sum equivalent to the entire cost of the inclined elevators every sixty days of operation. The first cost of the apparatus is reasonable and the mechanism is simple and reliable.

Fig. 2 shows an installation at the Mystic Dock of the Boston & Maine Railroad at East Boston, Mass., where loaded trucks are carried up or down and empty trucks carried down or up simultaneously. The success of this installation has led to an order for two more similar equipments on the same dock. Equipments of one, two and three machines each have been installed on the Metropolitan Steamship Company's dock at Boston; the Merchants & Miners' Transportation Company's dock at Savannah, Ga.; the Old Dominion Steamship Company's dock in New York; at the Pequonnock dock of the New York, New Haven & Hartford Railroad at Bridgeport, Conn., and at other locations.

The double-deck pier shown in Fig. 2 is a further adaptation of this method of carrying freight trucks from one elevation to another on the continuous principle, both up and down. Double-deck piers are coming more and more into use, and it is being recognized that in addition to the very great saving in the cost of the ground area they have a valuable economy in the handling and storing of freight. It can be readily understood that a two-storied pier as a freight storage proposition is twice as compact as an equal floor area would be if spread over one surface; that is to say, the distance from a central point to all other points on the two floors would be approximately one-half the distance of a central point from all other points when taken on a single floor.

The chief objection to a two-storied pier lies in the fact that half the freight needs to be carried up and down between the two floors. This objection, however, has been practically eliminated by the use of the continuous-working inclined elevator, which has a very large capacity as compared with ordinary elevators, and, furthermore, is safe in operation and very economical as to power consumed. A two-storied pier has an important advantage, in that it permits packages of freight, which usually remain in storage for several days or a week at a time, to be transferred to the upper floor on the inclined elevators, leaving the floor below available for the freight which needs to be carted away more rapidly.

The inclined elevators shown are manufactured by the Otis Elevator Company, Eleventh avenue and Twenty-sixth street, New York, N. Y.

The Economical Handling of Package Freight and General Cargo on Steamship Docks

BY C. A. HARDY

The handling of commodities from steamship docks naturally divides itself into two classes. In the first class is general cargo, consisting of miscellaneous ship package freight, in which the packages naturally vary in size and weight from the largest to the smallest. The other class consists of those commodities which, on account of the volume of traffic, can be loaded in solid cargoes.

Wherever the volume of this traffic has justified, special machinery has been designed and placed in service, which has effected large economies in handling. The most marked instances of successful work along these lines are found in the ore and grain handling on the Great Lakes. There has been considerable development in other lines, which have been mentioned from time to time in this journal; but such de-

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velopments are beyond the scope of this discussion, as special machinery and docks are required in each particular case.

The great volume of freight handled at ocean terminals is included in the first class, and consists of miscellaneous freight, and for the economical handling of this freight but little has been accomplished. The packages vary so in size and weight that the equipment designed to handle the heaviest articles cannot be operated economically on the lighter packages.

EARLY METHODS OF HANDLING FREIGHT

The general system in vogue has continued many of the crude systems of earlier days. When steamship service first came into effect all that was necessary was a plank dock wide enough for teams to drive out to the end and load and unload freight. Many of the modern docks continue this exact procedure. The ships were equipped with cranes of moderate capacity, which were operated by steam donkey engines, by which freight can be taken from the docks, deposited in the hold and loaded in the regular manner. Equipment of this kind suffices where only few cargoes are to be handled.

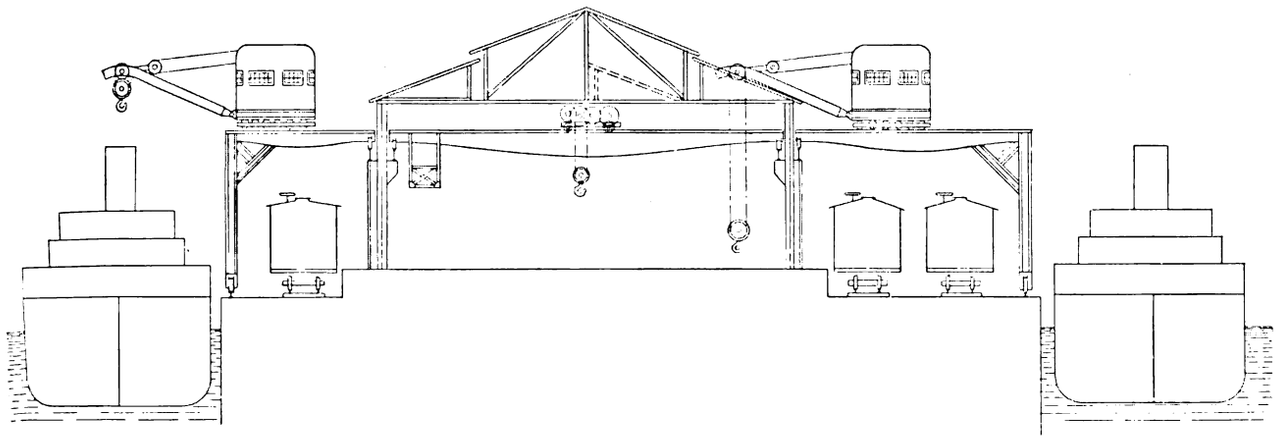
The next development, when the volume of freight increased, was to roof the dock over and use it as a storehouse, accumulating freight pending the arrival of a ship for reshipment and holding freight unloaded from the ship to suit the convenience of the consignee; in fact, using the dock as a freight warehouse.

These methods have served until the time has now arrived when the dock facilities at many important ports are overtaxed by the volume of freight to be handled. From an engineering standpoint the great difficulty of adapting modern crane service to the proper handling of freight arises from the fact that it is necessary for the crane to deliver freight at the hatchway of the ship and take it therefrom; this being approximately a point from 25 to 40 feet distant from the face of the dock. Consequently, swinging jib cranes mounted on a gantry framework have been developed on the Continent, and are in use at Hamburg, Liverpool, Manchester and elsewhere which are designed for this service. They can be constructed of sufficient capacity to handle all classes of freight at the proper speed. They can be arranged to operate either by steam or electricity, as desired. They can deliver freight readily at a point some distance from the dock side on the platforms of the warehouse, or in gondola cars or box-cars with sliding roofs, as used on the Tehuantepec Railway.

In order, however, to obtain the full economical benefit in service of this type of crane, the dock warehouse should be so designed that packages can be deposited by these cranes inside the building under the runway of another crane, and then picked up by a standard electric crane and taken to some designated point for storage or carried to the end of the building and set on drays or a lading platform as desired.

In order to properly supplement this service the dock should be laid with good concrete floors and electric truck service provided for handling small-package freight.

Trials have been made of the tram-rail systems, both electrically-operated and hand-operated, for handling this package freight; but owing to the fact that a roadway must be kept clear under the tram-rail for hand operators, and the fact that the hook can only handle packages stored directly under the runway, the storage room is limited, and a multiplicity of runways, switches, cross-overs, transfer cranes and complicated electrical equipment is required in order to fully utilize the storage space in the building, and consequently the tram-rail system is not as well adapted to the economical use of the space and the rapid handling of packages as a combination of the overhead crane and the electric truck.



Arrangement of Overhead and Traveling Cranes for Handling Miscellaneous Freight at Steamship Piers

COMBINATION OF OVERHEAD CRANES AND ELECTRIC TRUCKS

The sketch on this page shows an arrangement of dock combining these various features. Several sections in the roof of the dock warehouse are mounted on rollers, thereby allowing them to be swung to one side to allow the swinging jib cranes to take freight from the ship and lay it on the floor inside the warehouse under cover, where the traveling crane can pick it up and store it or pick up loads from the house and drop them into the hold of the ship. With this arrangement of traveling crane it is not necessary for teams to drive onto the dock proper. The cranes can over-run the team platform, pick up freight directly from the drays and also from the loading platform, carrying freight along the full length of the dock and deposit it at the proper point. By this arrangement the necessity of maintaining a clear roadway for teams the entire length of the dock is obviated.

With electric trucks package freight can be carried and properly distributed on the dock very quickly and much cheaper than with hand trucking. This relieves the overhead crane from the troublesome handling of small packages.

From investigations of the various methods of handling freight in freight warehouses, especially by the tram-rail system at St. Louis, the electric truck system on the Burlington Railway, the hand-trucking in various railway freight terminals, and package freight on the New York and San Francisco docks, cotton handling at New Orleans and Galveston, it seems certain that wherever the volume of freight is sufficient to justify the expense a material saving in handling miscellaneous package freight can be effected as outlined in this article.

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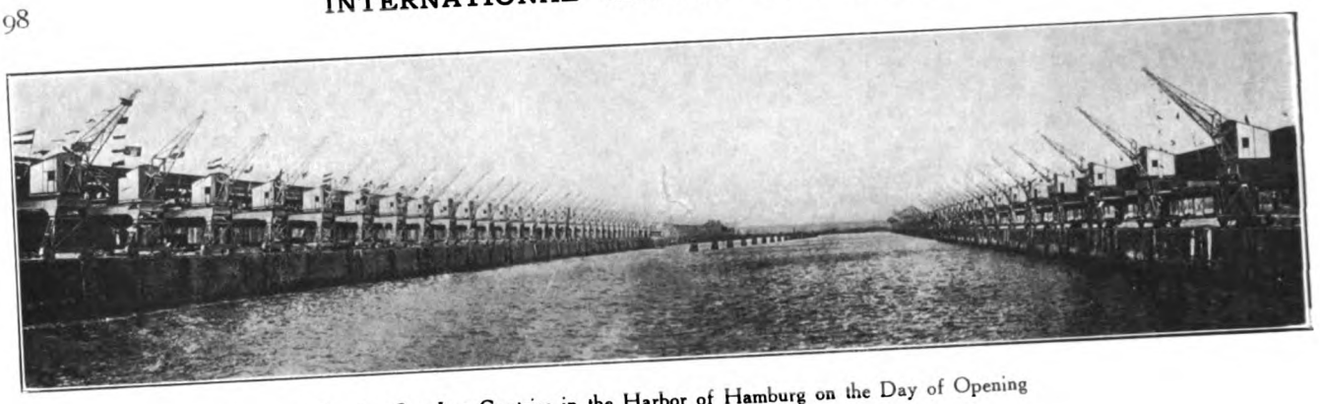

Fig. 1.—One-Leg Gantries in the Harbor of Hamburg on the Day of Opening

Electric Gantry Cranes for Terminals

Construction and Principal Features of the Electric Gantry Crane Widely Adopted for Handling Freight at Steamship Terminals—Tests and Costs of Operation

BY F. W. BUSE

It has been most interesting to note the extended movement toward the improvement of existing harbors and the development of new ports in the United States during the past few years. Various large cities have found it necessary to pay more attention to the development of their port facilities in order to retain their share of the shipping trade which might otherwise be secured by rival communities with improved facilities. The cost of handling and transferring the freight and the time which is required to load and unload a vessel are decisive factors for a steamship line in the selection of a harbor; it is therefore necessary for the harbor commissioners to give the selection of the loading appliances their utmost attention.

Just as it is impossible to have a standard layout from which a harbor can be built, the type and size of loading and unloading appliances cannot be determined without taking into consideration local conditions, the amount and class of freight to be handled, and the kind and size of the ships, etc.

Extensive Use of the Electric Gantry Crane

While unloading cranes and plants for coal and ore have been highly developed in the United States, it must be said that little attention has been paid to unloading devices for the regular package freight. Cranes for the handling of this class of freight have been developed, however, to a high degree of efficiency in Europe, and the electric gantry crane has been adopted as the most satisfactory means by all the large sea and inland harbors in Europe. In the ports of Hamburg, Bremen, Antwerp, Rotterdam, London, Liverpool, Havre, Marseilles, Genoa, Triest, Stockholm, etc., these cranes are used extensively. In the harbor of Hamburg alone over 400 electric gantry cranes are in daily service.

It seems reasonable to assume that the electric gantry crane will be adopted as the standard appliance for the loading and unloading of ships in the United States also. The ship's winch may be satisfactory where the goods have to be deposited close to the hull of the boat, but in modern harbors,

Fig. 2.——One-Leg Gantries with Luffing Gear in the Harbor of Hamburg

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where railroad tracks are arranged between the quay wall and the warehouses, and where the goods are loaded either into the cars or into the warehouses, or vice versa, the gantry crane offers the best solution of this problem. With its long jib it can not only cover a considerable horizontal distance but it can also reach a considerable height, and can deposit goods even into the second story of modern warehouses, laying them down on platforms in front of the doors, whence they are distributed in the inside of the warehouse by monorail trolleys or similar means.

change the outreach of the hook according to the beam of the steamer, especially if large quantities of goods have to be loaded through the same hatch.

The gantry can be built to span either one or more railroad tracks along the quay wall; the height is chosen according to local conditions. If the gantry travels by means of electric power, this movement is also controlled from the driver's cab. In case the gantry is moved along by hand power this is done through removable cranks turned by one or more men, according to the size of the crane.

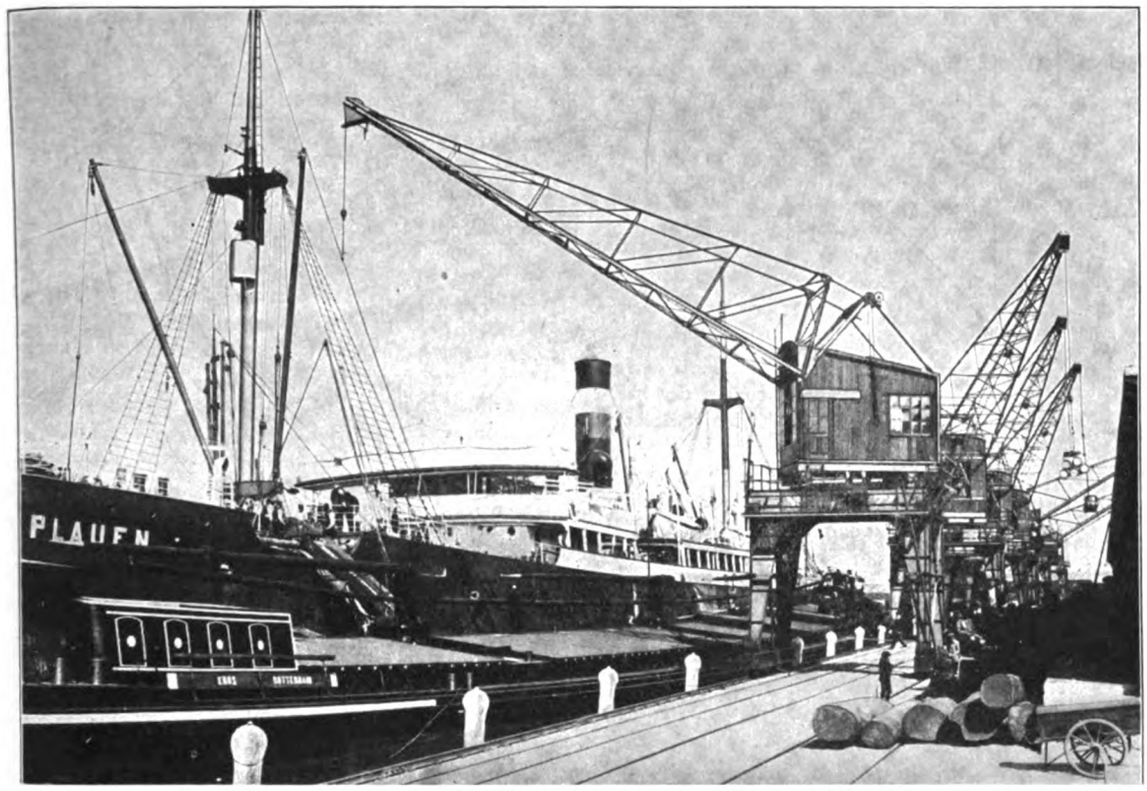

Fig. 3.—Two-Leg Gantries with Luffing Gear in the Harbor of Amsterdam

The purpose of these lines is to set forth the construction and the principal features of the electric gantry crane.

CONSTRUCTION

As will be seen from the illustrations the crane consists essentially of a one or two-legged gantry and a revolving jib crane on top of same. The gantry is moved either electrically or by hand. The hoisting and revolving appliances are driven by separate motors, and are arranged in the driver's cab, which is completely enclosed. The operator has his stand in the forepart of the cab, where large windows afford him a good view of the working field and protect him from the weather. The controlling apparatus is so constructed and arranged that an inexperienced man can handle the crane safely and with the least amount of manual work, so that he can give his entire attention to the movement of the load. The hoisting gearing can be built for work with an ordinary hook, or with a grab-bucket, self-dumping bucket, magnet or any other special lifting device.

In many cases the jib is made movable to give the hook a different reach from the center of the crane, as shown in Figs. 1, 2 and 3. If this is done the jib is luffed in and out by means of screws operated by the driver in the cab, either by hand or by power. Sometimes this is done for the purpose of lifting heavier loads at a smaller outreach without increasing the tilting moment of the crane, at other times it is desirable to

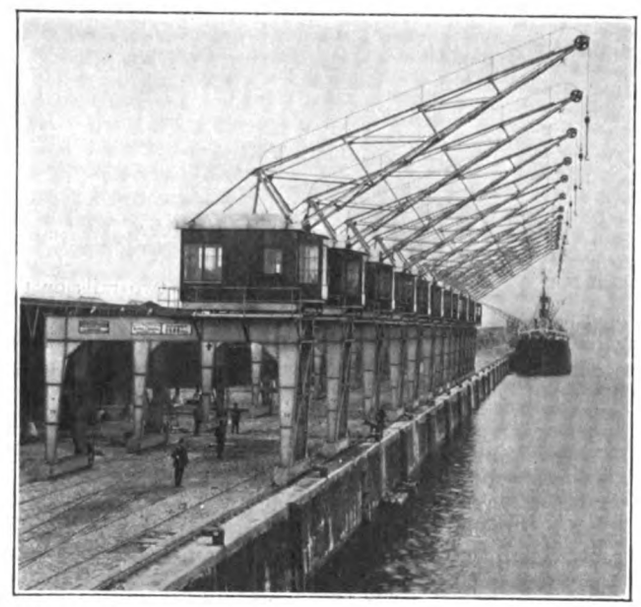

Fig. 4.—Two-Leg Gantries Spanning Several Tracks in the Harbor of Ghent

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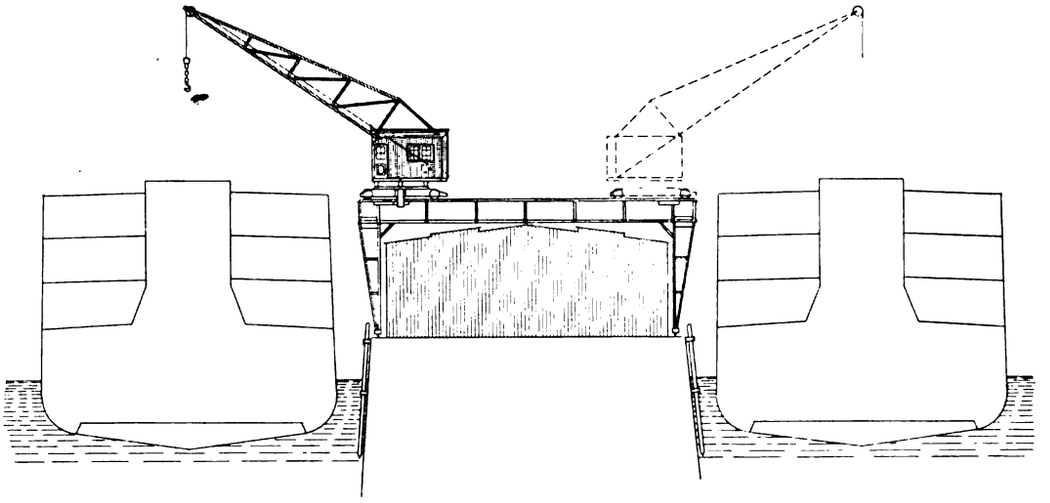

Fig. 5.—Application of Gantry Crane for Projecting Piers

CAPACITY AND ARRANGEMENT

Cranes for unloading package freight usually have a lifting capacity of 1.75 to 5.5 tons and a radius of about 40 feet, whereas the capacity of cranes for loading coal is not below 5 tons, and for unloading ore even more. As for the electric current, this can be either direct, alternating or single-phase up to 600 volts. The current is supplied to the crane by a flexible cable or by feed lines arranged below or above the floor in the usual manner. The general arrangement of the cranes on the pier can be seen from Figs. 1, 2, 3 and 4.

That the gantry cranes can be used to advantage on projecting piers is shown by Figs. 5 and 6. In Fig. 5 the gantry spans the entire building, and is running on two rails on the floor of the pier. The crane itself travels on the top of the gantry, and can serve ships on both sides of the pier. The goods can be brought into or out of the warehouse, either through the doors or through hatches in the roof. The hatches can be made as large as necessary, and can extend over the entire length of the roof. They can be shut by sliding covers, which might be operated by the crane. Where it is not advisable to have hatches in the roof the warehouse should be narrower, to allow more space between the warehouse and the gantry leg to provide for a platform on which the loads are deposited.

The arrangement in Fig. 6 provides for two cranes on the roof of the warehouse, working in the same way as described before. Instead of having two bridges, one bridge spanning the entire width of the roof may be arranged, on which one crane would work similar to the one in Fig. 5. In the latter case, the columns supporting the warehouse must be considerably heavier than those in Fig. 5. The advantage of the arrangement in Fig. 5 is that it can be used on existing warehouses.

LOADING CAPACITY AND CURRENT CONSUMPTION

Thirteen one-leg gantry cranes, which went through severe official tests and which were put into service only a few months ago, represent a good example of the loading capacity and the current consumption of a standard electric gantry crane. The cranes, which are similar to the ones shown in Fig. 2, have a maximum lifting capacity of 5.5 tons of 2,000 pounds. They are equipped with an electric-driven luffing gear, so that the radius can be varied between 52.8 and 36.4 feet. The horizontal distance between the two rails on which the one-leg gantry travels is 41.7 feet, the vertical distance between the top of the rails 28 feet. In the lowest position of the jib the top sheave is 70 feet above the lower rail. All the motions of the cranes, *i. e.*, hoisting, revolving, luffing and the traveling of the gantry, are electrically driven through separate direct-current motors of 550 volts. The hoisting gearing is provided with shift gears, so that loads of 1.75 tons can be lifted at a speed of 230 feet per minute, and loads of 5.5 tons at 80 feet per minute. A full revolution with the maximum load at the greatest outreach can be made in half a minute. Smaller loads can be handled at an increased speed according to the increase of

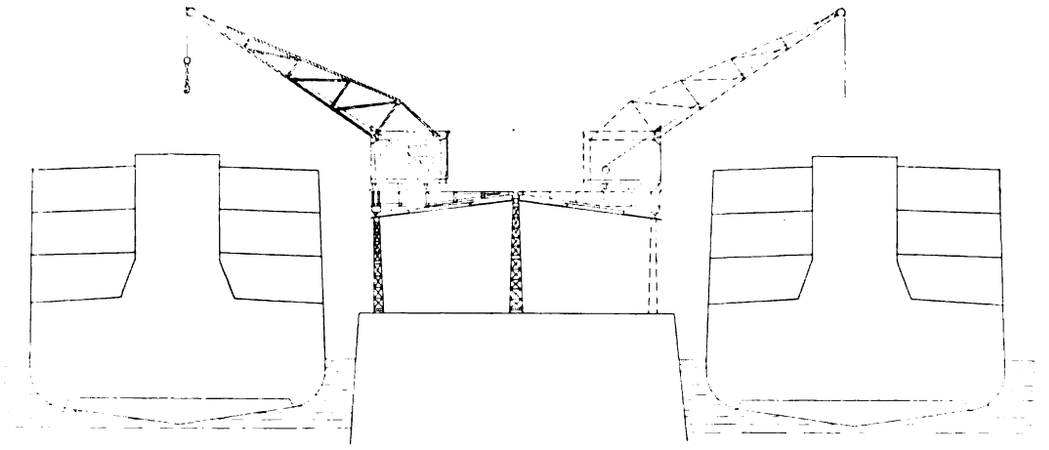

Fig. 6.——Application of Roof Crane for Projecting Piers

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revolutions of the direct-current motor at decreased load. The current is supplied to the cranes through a flexible cable, one end of which is fastened to a self-feeding drum at the gantry leg, whereas the other end can be connected to plugs arranged on the floor along the quay. The tests were made for the following cycle:

Lifting the load 29.5 feet.
Revolving with load through an arc of 120 degrees.
Lowering the load 10 feet.
Depositing the load (5 seconds).
Lifting the empty hook 10 feet.
Revolving back 120 degrees.
Lowering the empty hook 29.5 feet.
Attaching the load (5 seconds).

Results with a load of 5.5 *tons on hook:*
Time required for one cycle, 65 seconds.
Current consumption per ton of load, 50 watts.
Loading per hour 300 tons of 2,000 pounds.

Results with a load of 1.75 *tons on hook:*
Time required for one cycle, 50 seconds.
Current consumption per ton, 70 watts.
Loading per hour 125 tons of 2,000 pounds.

Assuming that the cost of current is 3 cents (0/1½) per kilowatt, the cost of current for loading *one ton* would be .15 cent when handling 5.5-ton loads, .21 cent when handling 1.75-ton loads.

COST OF OPERATION

When handling 1.75-ton loads during an eight-hour shift the capacity of the crane would be 1,000 tons and the current would cost $2.10 (8/9). For handling 5.5-ton loads the capacity would be 2,400 tons and the cost of current $3.60 (15/0). The current consumption was measured at the plug, and includes also the losses in the wiring.

While the above-mentioned loading capacities will naturally not be obtained in the regular service owing to the variation in the weight of the pieces, and unavoidable delays in handling same, the current consumption will not vary much from the figures given. A saving of time can be made by combining two different motions; *i. e.*, lifting and revolving, etc.

Like every other machine the crane shows the highest efficiency when working with the full load for which it is designed. It is decidedly advantageous to install cranes of a capacity with which they have to work the greater part of the time. If it should be necessary to lift heavy loads two cranes can be employed lifting simultaneously. In large harbors it has been found practicable to install some cranes of higher capacity besides a majority of cranes of the standard size.

Owing to the simplicity in construction and the strength of the cranes their handling and upkeep are simple and cheap. The life of one of these gantry cranes can be taken at about twenty-five years, but it naturally depends upon their handling. The expense for lubrication, cleaning and upkeep amounts to about $60 (12/10/0) per year for the first few years and increases slightly.

A calculation based on the above-named cranes shows that including the wages of the operator, current consumption, depreciation, interest and upkeep 1 ton of freight can be unloaded for about 1 cent (0/0½).

CONCLUSIONS

In summing up the contents of this brief article the following main features which recommend the use of the electric gantry crane, and which appear clearly in the illustrations, may be mentioned. Besides a comparatively low initial cost and upkeep the cranes have a large loading capacity and a high efficiency. The cost of operation is low, because only one man is needed for the handling of a crane, even under the severest conditions. They occupy small floor space, and no part projects permanently beyond the quay wall. The hook can easily be brought in and out between the masts, and the crane can work in any weather, as there are no parts employed which are affected by either heat or cold.

The illustrations show cranes built by the Deutsche Maschinenfabrik at Duisburg, Germany (also known as "Demag," and represented in the United States by Messrs. Neumeyer & Dimond, New York), who have been instrumental in the development of the electric gantry crane during the last fifteen years, and who have built many hundreds of these cranes, among which are the above-mentioned cranes.

Patent Barge for Coaling the Imperator and Other Large Hamburg American Steamships

BY F. C. COLEMAN

A patent barge, intended for the coaling of the *Imperator* and other large vessels of the Hamburg American Line, has recently been built by the Antwerp Engineering Company, of Hoboken, Belgium. This craft consists primarily of a large pontoon-like vessel, upon which is mounted a superstructure, the height of which varies from 32 feet to 60 feet above the waterline to the underside of the tower platform.

The vessel, built to the highest coasting class of the German Lloyds, has the boiler and machinery aft, and the crew space, etc., forward, the 'midship part being divided by bulkheads into sixteen compartments. The bottom of these compartments is not fixed, but consists of a hinged door each side of the center. These doors are raised at the outside edge to an angle of about 45 degrees by a pair of hydraulic rams, causing the coal to fall to the center line, when so much of the coal has been taken out of the compartment that it will no longer run at the bottom of each compartment. At the center line are three hoppers closed by sliding doors worked by a weigh shaft running the whole length of the coal compartments, to which each door is coupled separately by pneumatic clutches, controlled from the deck.

Along the center line of the ship between the center girders up the forward leg through the tower top and down the after leg, forming an endless chain, runs a series of buckets, each containing about 3 cwt. of coal. On their journey through the tower the buckets are upset by a dumping apparatus, the coal falling into fixed shoots, and thence into cylindrical telescopic shoots having a universal joint at the underside of the tower platform to enable them to hang in any direction into the bunker hatches or side ports. By a special arrangement of the hoppers the coal can fall only into the buckets, instead of, as in previous designs, the bucket chain having to be virtually dragged through the mass of coal which is pressed on the buckets as soon as the hopper doors were open.

To prevent large lumps of coal falling into the buckets or blocking the hoppers, revolving pricker knives are fitted, worked from shafting running the whole length, and each set connected independently by pneumatic clutches controlled from the deck.

An ingenious arrangement is fitted to control the admission of the water to the hydraulic rams to ensure the bottom doors lifting evenly, while another device prevents the buckets from becoming over-filled. The elevator chain is actuated by an 80-horsepower steam engine, the steam being supplied from a 100-square foot heating surface Cochran boiler. Electric and pull signal bells and electric lights are fitted throughout.

Suspended from the underside of the tower is a grab runway derrick crane, with a luffable jib about 50 feet long, working a 2-ton grab and loading coal into the barge at the rate of 180 tons per hour. This grab derrick is worked by a 165-horsepower motor from a 200-horsepower, direct-coupled condensing engine and dynamo, and fitted throughout with the

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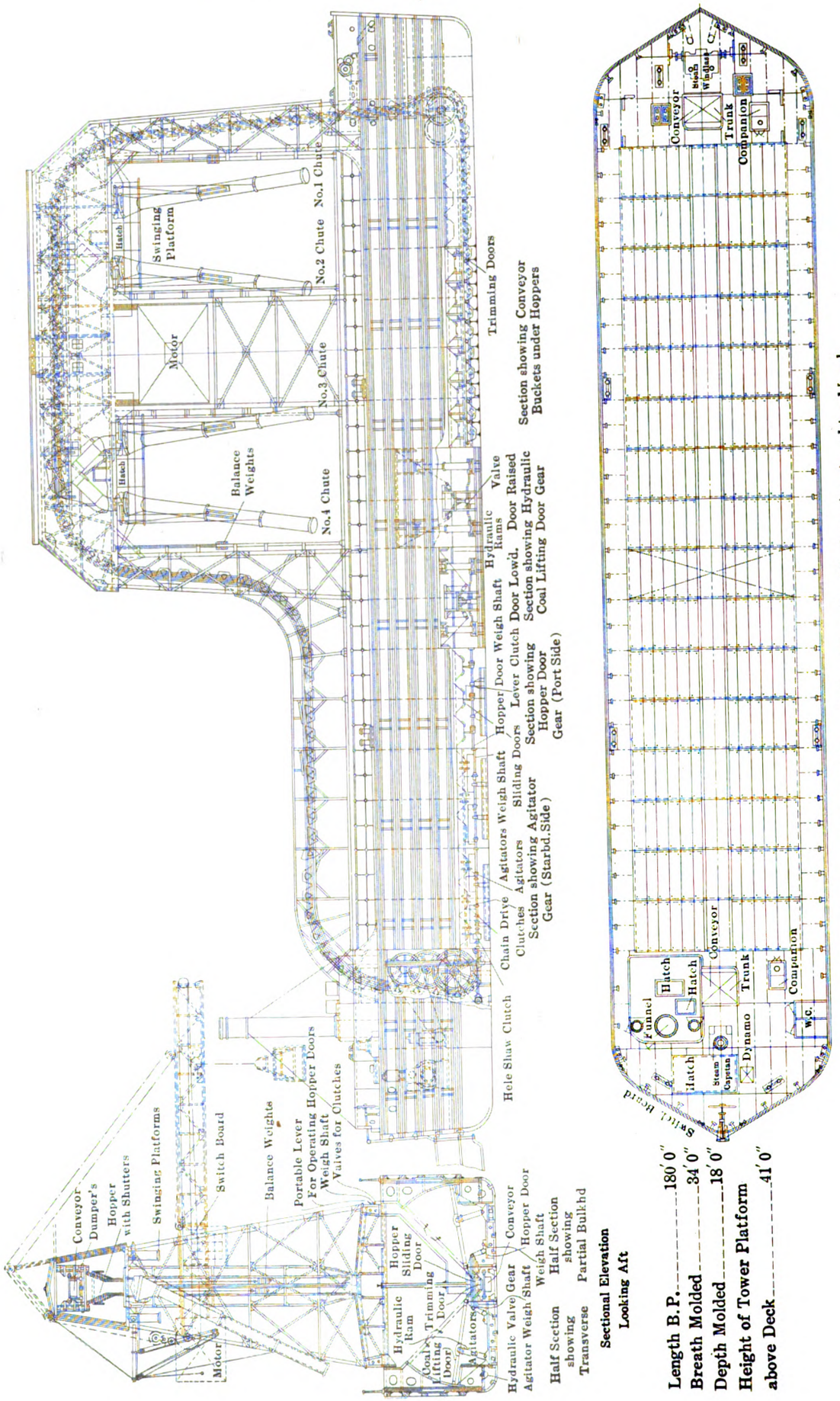

Fig. 1.—Section, Profile and Plan of Patent Coaling Barge for Hamburg American Line Vessels

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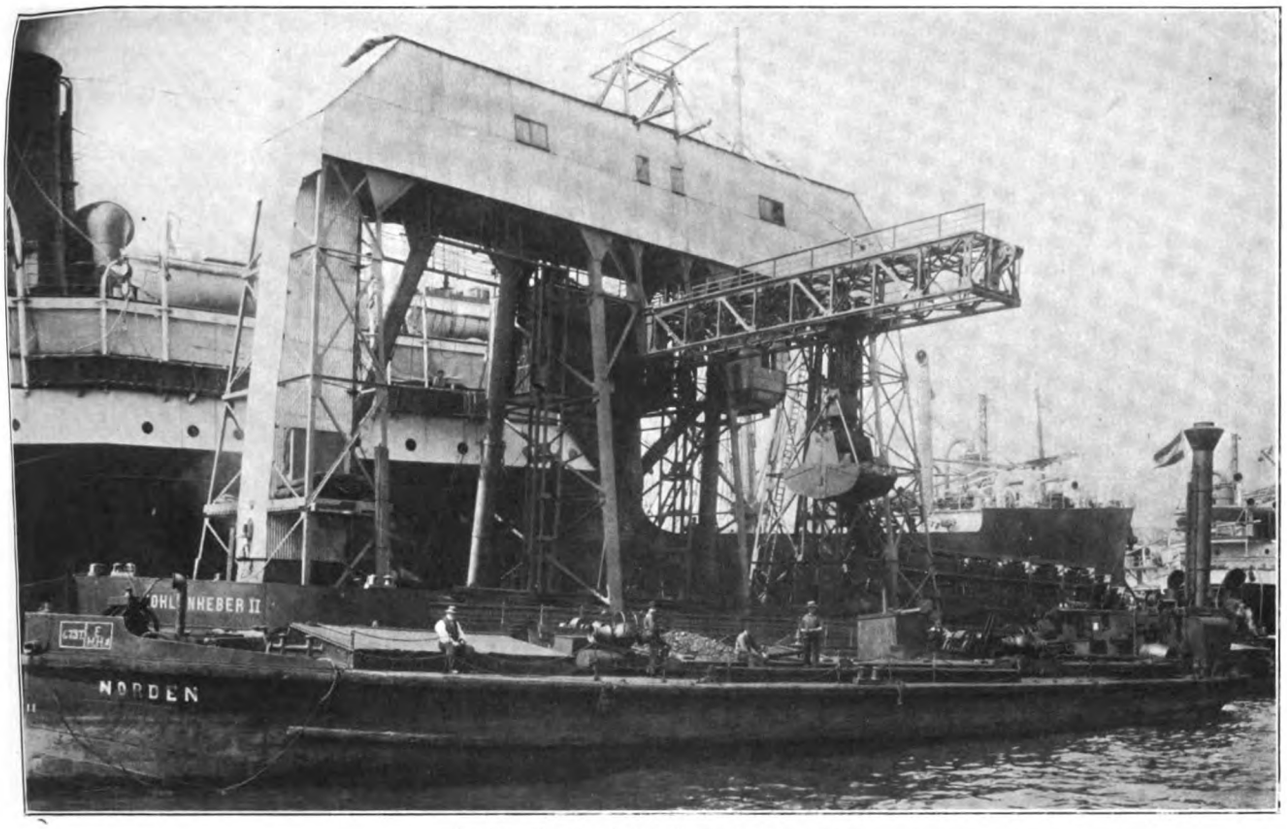

Fig. 2.—Patent Coaling Barge in Operation

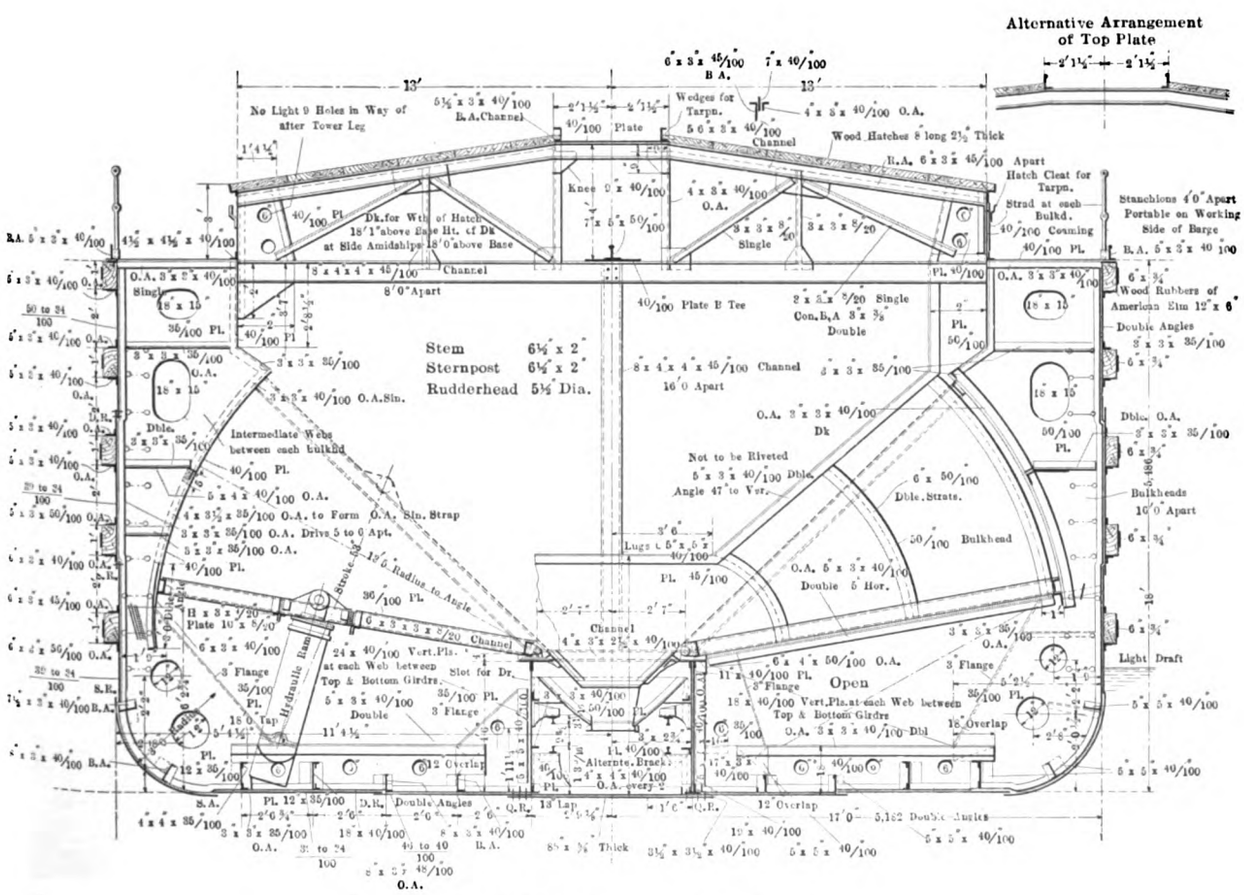

Fig. 3.—Midship Section of Coaling Barge

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Leonard system of control, whereby all of the motions of the grab, lifting, lowering, running in and out, and the opening and closing of the grab are actuated by a single lever.

The present barge discharged on trial over 250 tons per hour, at the same time taking on board 180 tons per hour with the grab from coal barges alongside. The coaling barge loads in itself 1,250 tons of coal, so that, when discharging 250 tons per hour, and leading into itself 180 tons per hour, it is possible to work into bunkers nearly 18 hours, or 4,500 tons of coal, without refilling at the tips.

The Overhead Wharf Crane

BY HARRY SAWYER *

Until recently the problem of rapid and economical handling of miscellaneous package freight has received but scant attention in America. While the quays and piers in important foreign ports have been equipped with cranes for general cargo, the equipment at our own ports has been confined almost exclusively to means for handling uniform cargo, usually bulk material such as coal, ore and grain. But improvement in this condition seems assured. With the very general awakening to the necessity for more and better port facilities, so noticeable in the past two or three years, has come a realization that mechanical appliances must be installed, and, in most of the port development work now under construction or projected, some form of miscellaneous freight-handling apparatus is contemplated.

The problem of freight handling at a marine terminal naturally divides itself into two parts: the loading and unloading of ships and the handling of the freight on the pier. Close relation of the two is important, but it is the purpose at this time to discuss only the former.

It is not likely that any of the European types of wharf cranes will be found satisfactory and will be adopted for our American ports. A new type that will meet the most rigid requirements of speed, safety and economy is illustrated in the accompanying cuts. This crane is a radical departure from foreign practice in several essential respects, as indicated below:

It travels on elevated tracks above the roof of the shed, leaving the floor unobstructed.

It carries freight to and takes it from a point well within the shed, where it is protected from the weather.

It carries freight between the ship and the shed in a straight line at right angles to the edge of the pier, which is the shortest course.

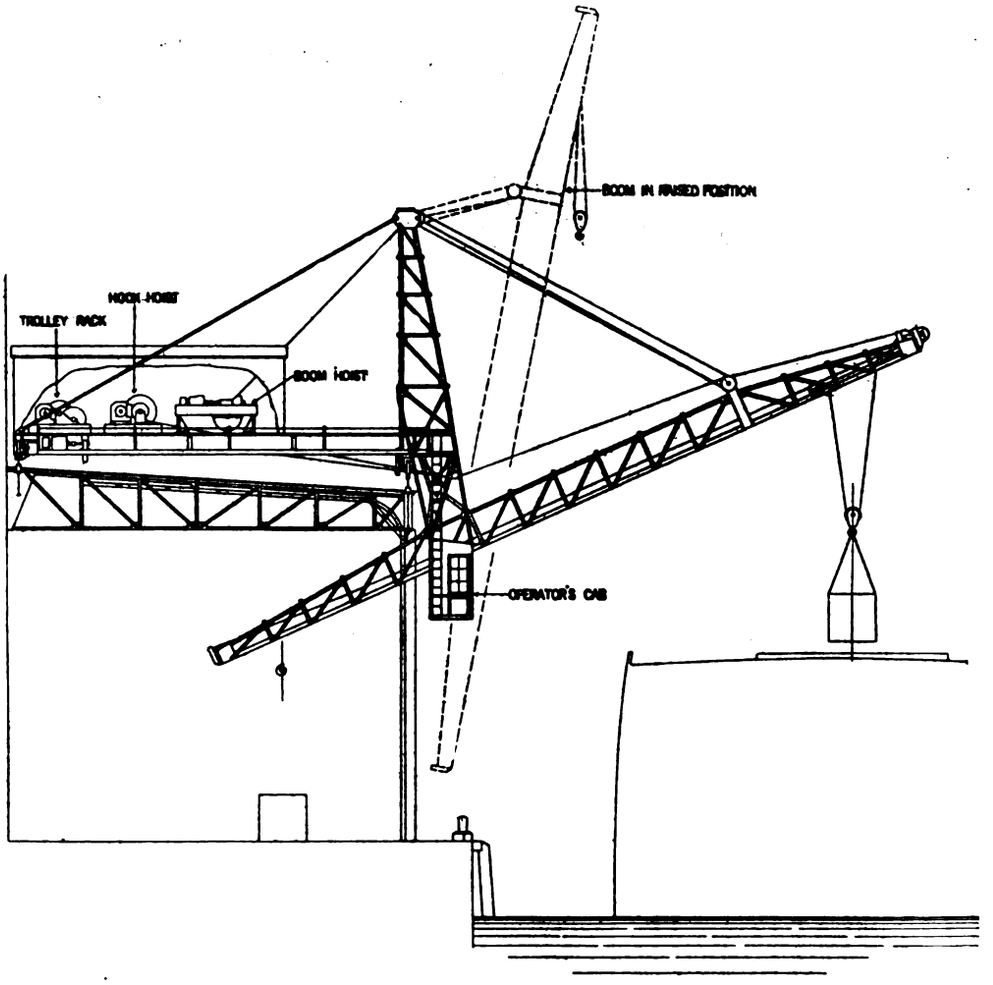

Fig. 1.—Shaw Overhead Wharf Crane

Freight is handled more safely and with less loss by breakage, because swaying of the load is, to a great extent, avoided and more perfect control secured.

To those responsible for the construction and equipment of piers it must be apparent that the pier deck area is too expensive and too valuable to be used unnecessarily for crane tracks and crane structure. No manufacturer would for a moment think of equipping his shop with cranes of the gantry type running on tracks at floor level, and there is even more reason for mounting wharf cranes on elevated tracks, for, at a busy marine terminal, congestion is often greater and space more valuable than on the shop floor. The advantages of

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reaching inside the shed with the crane are obvious. The freight is placed under the roof and where it can most conveniently be sorted and checked.

The direct or straight line travel between ship and shed is in every way better than the circular course of the swinging crane mounted on the portal or semi-portal base so common abroad. The direct course is shorter, quicker and cheaper. There is less tendency of the load to sway, because of the straight line movement and because it is suspended on a

can be raised to a nearly vertical position, in which position the lower end is withdrawn from the shed and the upper end is removed from over the ship. The shed doors can then be closed, the crane can be moved to another position, and the ships can sail or dock without interference with the crane boom.

The machinery for the various motions, hook hoist, boom hoist and trolley rack is placed well back on the supporting frame, where it acts as a counterweight, giving stability to the

Fig. 2.—Adaptation of Overhead Wharf Crane to Ordinary Steamship Pier

much shorter length of rope as it approaches the place where it is to be landed on the shed floor.

In the swinging crane a large mass of machinery, including hoisting and slewing mechanism, frame, boom and, in fact, all rotating parts, must be started and stopped for every horizontal movement of the load or empty hook. In constantly overcoming the inertia of this great weight there is unnecessary loss of time and power and increased machinery depreciation. The swinging or circular motion crane has long since given way to the straight line motion crane for industrial purposes, and the straight line motion is equally superior for wharf service.

The boom of the overhead crane when in working position stands with the outer end extending over the ship and the inner end projecting through the door into the shed. The usual working angle is 24 to 30 degrees from the horizontal; but this angle can be varied as the height of the boat and other conditions may require. A light trolley, from which the hoisting block hangs, travels out and in from one end of the boom to the other. When the crane is not in service the boom

crane. The cab, from which all movements are controlled, is suspended in a position to give the operator the best view of the load.

The overhead wharf crane is particularly well adapted to those terminals in which a railroad track is extended along the edge of the pier. Having no supports outside of the railroad track the space is entirely clear, so that long material, such as poles, railroad rails and structural steel, can be handled between ships and cars without swiveling.

This type of crane can be built to operate on tracks carried over the roof of a two-story freight shed, and serve both the first and second floor. To meet this condition the boom is carried on a vertically adjustable member. The shift from one floor level to the other must, of course, be made with the boom in the vertical position. The reeving of ropes is such that the position of the lower block relative to the trolley, the position of the trolley on the boom, and the angularity of the boom are not affected by the vertical adjustment.

For piers on which the shed is placed so far back that it is not practical to reach the ship from overhead tracks, a crane

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is recommended having the same boom and operating machinery, but traveling on one elevated track carried by the building columns and one surface track at the edge of the pier. Such a crane gives the same advantages of direct and rapid handling but not the unobstructed pier.

A capacity for handling loads up to 6,000 pounds is considered sufficient for most terminals, but this, as well as the reach, span and other dimensions, can be varied to meet local requirements. The crane shown, having an effective reach of 40 feet beyond the edge of the pier, is stable with more than double its normal load in the extreme position, but to make tipping impossible under any conditions hooks are provided, projecting under the flanges of the rear runway.

A comparison of costs, it is claimed, shows that freight is handled as cheaply at our ports with a combination of ship and shore winches as in European ports with wharf cranes. This seems not at all impossible when we consider the type of cranes there used, and the course of our port commissioners in not installing general cargo cranes in the past may be justified; but the comparison must not be accepted as proof that no crane installation can be made that will be faster and cheaper than our present methods. A very considerable saving should result from the use of the overhead crane as compared with other types of cranes or the ship's tackle and stationary winches, on account of the greater practicable speeds, the shorter course traveled by the hook, and the fact that one man controls all movements.

A factor of importance is the reduced damage to freight from rough handling. Swaying is unavoidable when a load is suspended by long ropes from the end of a swinging boom, and is sometimes resorted to, in connection with the use of ship's tackle, as a means of throwing a sling load of freight inside the shed. The perfect control and absence of serious sway avoid the principal causes of damage to freight handled by other means.

The demand for greater economy and dispatch is imperative. Apparatus that will reduce the time a ship must remain at the pier, reduce the labor cost, reduce the damage to freight and increase the capacity of the pier, will go far toward solving the marine terminal problem.

Concrete Docks versus Wooden Docks

American Dock Engineers Following the Lead of Their European Contemporaries in the Adoption of Concrete Docks

BY HARRISON S. TAFT

With the vast harbor developments being made at nearly all of the Pacific Coast ports in the United States, preparatory to the opening of the Panama Canal, the question of a suitable type of dock construction is occupying a prominent position in the minds of Pacific Coast dock engineers. In San Francisco Bay and other California ports the dock engineers have developed a special type of concrete dock, consisting of concrete columns, concrete-encased steel or reinforced concrete beams and a concrete deck slab. Another type of construction consists of using wooden piles encased in a watertight concrete shell, with a suitable concrete deck beam and slab system. Still other California ports are developing a type of semi-concrete dock, viz.: concrete piles supporting a wooden deck structure. Since California is some 1,000 miles distant from the lumber supply of Puget Sound forests, her ports would naturally precede those located on Puget Sound in adopting concrete for dock construction.

Puget Sound being surrounded by a forested country it was only natural, with the rapid growth and expansion of that section of the country which followed the discovery of gold in Alaska in 1898, that wooden piles should have been extensively and exclusively used in the dock work of Puget Sound shipping ports. Up to the present time no attempt has been made in the way of using reinforced concrete in the dock work of either Seattle or Tacoma. The only location on Puget Sound where concrete docks exist is at the United States navy yard, Bremerton, Wash.; one being 60 feet by 402 feet, built in 1911, the other 80 feet by 490 feet, now under construction (1914). Farther to the north, at Vancouver, B. C., the Great Northern Railroad Company recently completed (1913) a quay type of reinforced concrete dock in connection with an extensive water-front terminal. This dock is the only commercial concrete dock on the Pacific Coast north of San Francisco.

In adopting concrete for marine structures a far different problem is met with than in the use of it in buildings or other dry-land structures. On the other hand, in using wooden piles for dock work the dock engineer has to contend against an equally different problem than in using wood in land structures. With wood the destructive sea borers have to be contended with and the damage they do provided against. In the use of cement in sea water the chemical action of the contents of salt water upon the properties of cement has to be studied and provided for. With either type the dock engineer has to sail his ship between the Scylla and the Charybdis of the problem, with the "rock of cost" standing out ahead of him.

TEREDO THE ENEMY OF WOODEN DOCKS

Since the teredo will destroy a green wooden pile inside of eleven months in Puget Sound waters, in nine months in San Francisco Bay, with a record of six months in Alaska, the annual cost of replacing the fender pile system of these docks is a very serious problem. When it is considered that a creosoted-pile dock is good for about ten to twelve years in San Francisco Bay, and twelve to fifteen years in Puget Sound ports, the question of the continued rebuilding of wooden pile docks, and the cost of doing this every ten or fifteen years, are beginning to receive serious attention, not only on the part of Pacific Coast dock engineers but by the public in general.

In Atlantic coast ports, north of Cape Cod, the waters are so cold that they are uninhabitable by teredo, compared with those ports nearer the Gulf Stream. In Boston oak piles can be used with success even when they support a reinforced concrete deck structure. Thus semi-concrete docks can be successfully built and operated in the waters of Massachusetts Bay and vicinity, the wooden piles being cut off at mean high water with the rest of the deck structure built in reinforced concrete.

Along the water front of New York City and the Jersey shore, where sewage is destructive of teredo, the semi-type of construction, viz.: wooden piling and concrete decking, can be and is used extensively. Unless the piles are cut off at or below mean high tide—the lower the better—that part of the structure exposed to alternate wet and dry conditions is destined to rot away with the same speed as if the whole structure were of wood, since the part below low water will last as long in one case as in the other. Such a type of semi-

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concrete dock, having the wooden piles cut off at low water, is far more preferable.

Farther down the Atlantic coast the teredo are so destructive of wooden structures standing in the sea water that some type of concrete piles becomes a necessity, if the rebuilding of the docks at the end of every ten years or so is to be avoided. In some of the Southern ports are found concrete pile, wooden-deck docks, full concrete docks of various designs, concrete encased wooden piles with a concrete deck beam and slab system, all depending upon the location and purpose to which the dock is to be put.

While concrete may be a long-enduring material in land structures, unless it is made of proper material, properly mixed, handled and cured, it would perhaps be far better not to use it in that part of dock structures standing in sea water carrying the main loads, viz.: the concrete columns or concrete piles. When made of suitable cement, suitable sand and stone or gravel, properly mixed and cured, there is no reason why concrete should not be made a lasting material for salt water structures, barring any serious damage due to collision, etc.

SELECTION OF MATERIALS OF FIRST IMPORTANCE IN CONCRETE DOCKS

In using concrete in dock work, not only is it necessary to carefully study and analyze the different materials out of which it is made, especially in salt water structures, but the question of impermeability must receive the closest attention in waters subject to frost action, be they fresh or salt; the problem reducing in the last analysis to the harmonious and united co-operation of the chemist and concrete engineers. North of Cape Cod a number of well-known failures have occurred in using concrete in dock and sea wall work, due to frost action upon permeable concrete. Serious difficulty has also been experienced at the Brooklyn navy yard with the use of concrete in one of the dry docks; the exact cause of which does not seem to have been fully discovered. On the other hand, in the port of Dundee, Scotland, where the climate is said to be as severe as in Boston, concrete pile docks are stated to have proved a success, with no injury to the piles due to their standing in frost-affected sea water.

After the dock engineer has satisfied himself that concrete can be successfully used in sea water structures, and that a concrete dock can be made a practicable engineering structure, questions of comparative initial cost and annual upkeep charges become a serious problem for him to consider—the more interesting the deeper one goes into it.

The annual overhead charges on a wooden dock structure, due to sea borers and to natural decay on account of dampness and severe treatment, are most excessive. Multiplied by the number of years a wooden-pile, wooden-deck dock will last in teredo-infested water, and added to the cost of rebuilding, the total charge against the wooden structure, steadily increasing with the beginning of each subsequent dock period, becomes of more vital importance, compared with a similar set of figures covering concrete docks (with no rebuilding) than does the difference between the first cost of the concrete dock and of the wooden pile structure when located in teredo-infested water.

Not only must the practicability of using cement in sea water and the advisability of using wooden piles in teredo-infested harbors be carefully studied by the dock engineer, but questions of type of design, first and rebuilding costs, fixed overhead charges, such as maintenance, fire insurance, taxes, interest on investment, refunding of bonds, operation expenses, etc. (entitled for the want of a better name, "dock finance"), must be carefully weighed, one against the other, as affecting wooden dock versus concrete dock construction; all without losing track of the fact that no matter what the type, or what the design, unless the dock will stand up and do its duty, the less the number of docks built the better for the community.

CONCRETE DOCKS EXTENSIVELY USED IN EUROPEAN PORTS

America being a forested and non-maritime country has hitherto been far in the rear compared with foreign nations in the development of her port facilities. While England is absolutely dependent upon her shipping for an existence, Germany and other European nations are depending upon shipping for their raw materials and for the exporting of their finished products. Thus European ports with vast and up-to-date shipping facilities are far in advance of those in this country. Whereas European nations have not made such extensive developments of reinforced concrete dock construction as England, in England are found a large number of such structures, some of vast size and costing many hundred thousand dollars. In fact, there is hardly a port in England in which reinforced concrete docks do not exist, most of them having proved a success, constructively as well as commercially. If reports of the English dock engineers are true, the annual maintenance cost of concrete docks is about one-tenth of 1 percent—practically nil. This compared with figures quoted for New York harbor docks, and actually experienced for Puget Sound structures, is a most marked figure.

Now that oil fuel is becoming so generally used in the American merchant marine, especially on the Pacific Coast, it is fitting to speak of a new item that presents itself in a discussion of concrete docks versus wooden docks. Suppose the oil fuel became spread out on the water underneath a wooden structure, and accidentally became ignited, would not a conflagration be liable to start that might mean the destruction of property worth far more than the difference between the cost of a wooden and concrete pile structure? Even of recent date wooden pile docks have been destroyed by fire, and no one knows which one will be the next. It is unnecessary to recall the disastrous fire at the Hoboken docks some years ago or of the destruction of the Newport News piers by fire in 1897. Wooden docks will burn even if they do stand in water, and the results of a sea of fire under and around a wooden structure can be better imagined than described.

With due respect to the American dock engineers, it must be admitted that in the adaptability of reinforced concrete the European engineers are far in advance of their American contemporaries, especially in the use of concrete in sea water structures. Still a review of the concrete docks built in this country since 1906 will show at least thirty-six such structures of various types of construction now in operation, all no doubt having fulfilled the expectations of their designers, so much so that their numbers are steadily increasing on all three of the coasts of the country, viz.: Atlantic, Gulf and Pacific, not omitting the Great Lakes. Without doubt they will continue to do so, as their worth has been proved by actual experience, with semi-concrete docks as well as full concrete structures of various types and designs.

NATIONAL MARINE ENGINEERS' BENEFICIAL ASSOCIATION.—At the thirty-ninth annual session of the National Marine Engineers' Beneficial Association of the United States of America, held in Washington in January, the following officers were elected for the coming year: National President, William F. Yates, New York; First National Vice-President, E. C. Mausshardt, San Francisco, Cal.; Second National Vice-President, George H. Bowen, Port Huron, Mich.; Third National Vice-President, C. N. Vosburgh, New Orleans, La.; National Secretary, George A. Grubb, Chicago, Ill.; National Treasurer, A. L. Jones, Detroit, Mich.

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Handling Steamship Package Freight

Limitations of Overhead Crane and Telpherage Systems—Advantages of Electric Trucks for Overcoming Congestion at Steamship Piers

BY WILLARD C. BRINTON

The time required for unloading and loading a ship usually depends on how rapidly work is handled in the small space on the pier immediately opposite the hatch. In this small space, usually not over 15 feet square, drafts of goods must be received or must be made up for hoisting. As most piers are of but a single story, and the ships of to-day have high sides, drafts of goods from the ship to the pier must be lowered with care or workmen will be injured. Material placed on the pier in sling loads must usually be picked up, package by package, and moved to the proper piles on the pier. It is this picking up of individual packages which delays the work when unloading.

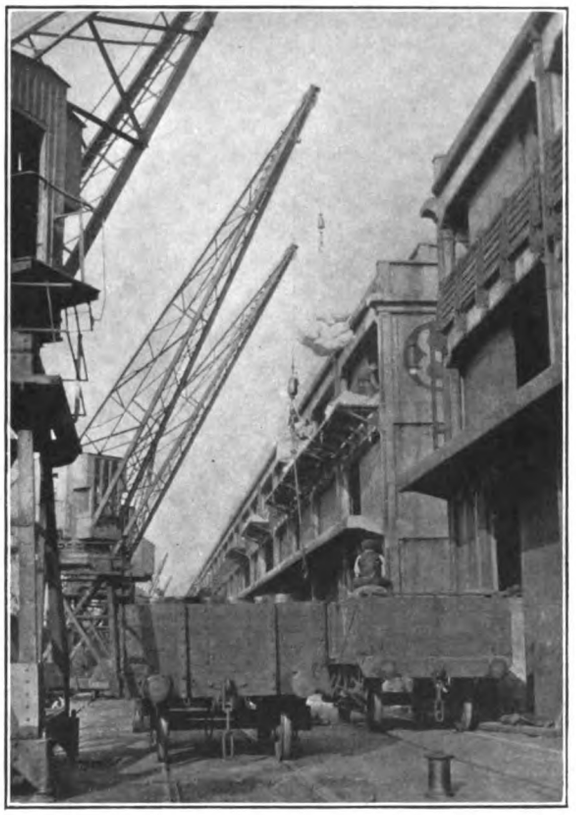

Fig. 1.—Unloading American Flour at the Three-Story Concrete Pier Sheds of the Manchester Ship Canal Company, Manchester. Note the Cranes Waiting Because the Bags Are Not Taken Away Rapidly Enough

The hand truck is a universal tool by which outbound material is moved from different parts of the pier to the side of the ship. Though the hand truck is a wonderfully universal instrument, which is assured of use far into the future, it has serious limitations. The ship's tackle in America, or the harbor crane in Europe, has progressed to such an extent that they have completely outgrown the hand truck. It takes several hand-truck loads to make up one load for the hoisting machinery. As a result, the usual practice is to lay down a sling on the floor of the pier immediately opposite the hatch, and then load into this sling material from several different hand trucks. Only one sling load can be made up at a time, and the ship is kept waiting longer than desirable. At most stages of loading a ship it is possible to stow material into the hold faster than sling loads are made up one at a time on the pier. Though there may be plenty of room on the pier as a whole, the only space which counts is that immediately opposite the hatch. Only a few men can work in this space, and it is not easy to improve conditions as long as sling loads are made up at the side of the ship.

It is seen, then, that the time in handling cargo, both in unloading and in loading, depends upon the speed of handling in the small space on the pier immediately opposite the hatch.

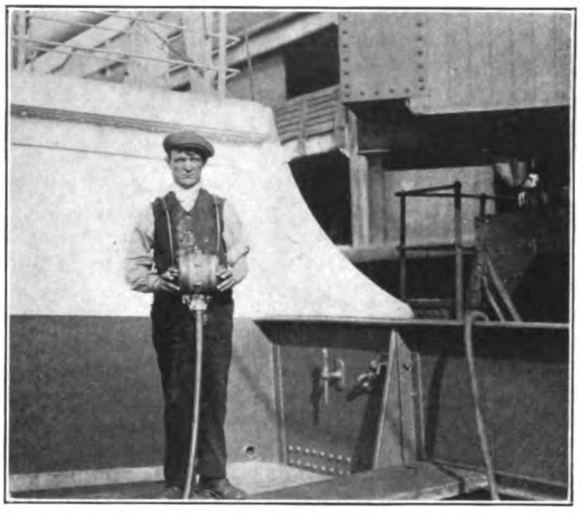

Fig. 2.—The Holmes Patent Controller, Used for Harbor Cranes, Manchester. One Man Carrying the Controller Can Do the Work Formerly Requiring Two Men for Each Crane. The Crane Operator is on the Ship Where He Can Look Down into the Hatch. Because of the Instantaneous Crane Control Time is Saved and There is Increased Safety for the Workmen

It is possible to put on an almost unlimited number of stevedores radiating from the side of the ship to different parts of the pier. It is also usually possible to put on more men in the hold of the ship so that several sections in the ship may be worked simultaneously from any hatch. The hoisting tackle is sufficient in capacity to make many more trips per hour than it usually does make. It is the space on the pier opposite each hatch which causes the restriction on rapid freight movement. This small space could be likened to the neck of a bottle, or rather to the neck of an hour-glass, which entirely fixes the time required for material to pass from one side to the other.

The cranes used for handling freight at European seaports do not solve the problem. The crane only transfers the congested area from the immediate side of the ship to a point 30 or 40 feet away where the crane receives or delivers its load. The same problem of assembling sling loads, or of separating packages from a sling load, appears at the point where the crane ends its travel at the shore side of its total movement. The use of cranes does not affect the speed in any way in this particular phase of the work, for the crane is essentially the same as the ship's tackle used in burtoning.

Theoretically, the overhead telpherage system might solve

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the difficulty if the overhead telpherage system is laid out in such manner that material could move between the hatch and any part of the pier without stopping at the side of the ship. The space on the pier immediately opposite the hatchway could be neglected entirely if we had high-speed telphers working on a track loop which could be placed from the side of the pier over the hatch. Whether telphers will ever be widely used in this manner for mixed freight of many marks is, however, very doubtful. There are serious limitations to even the most ideal machinery which can be imagined if that machinery must run on tracks. It is only by abandoning the idea of tracks that absolutely free movement can be obtained.

Telpherage systems have not been developed to a great enough extent for us to have available to-day a complete line of apparatus which would have the high speed and extreme flexibility we should desire if an overhead freight-handling system were to be installed. Let our imaginations gallop, however, and assume for the moment that we have available to-day high-speed overhead telpherage apparatus of an, as yet unattained, ideal type. Such an ideal telpherage system could not be installed in the average pier shed found in America, for the reason that the head room is not sufficient. If the telpherage system were installed in the present pier sheds, there would not be sufficient height for piling goods beneath the telpher to give an economical pier for operating, taking into consideration the very great investment due to the telpherage system alone. In order to get the right kind of conditions for operating a telpherage system we must ordinarily have a completely new pier shed with greater overhead clearance than found in the average shed now in existence.

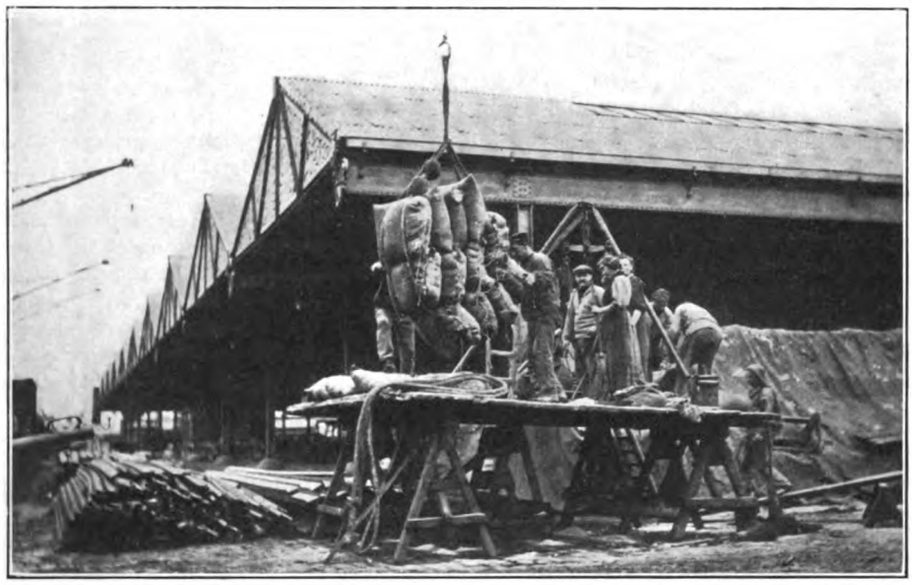

Fig. 3.—Receiving Goods From a Crane at the New Harbor of Antwerp, Belgium. The Speed of Unloading the Ship is Limited to the Speed at Which Goods are Handled on the Small Platform. Note the Scales With Equal Length Beams and the Women Assisting in the Work

Fig. 4.—Teams Delivering Outbound Freight to the Piers of the New England Navigation Company, New York. The Teams Unload Onto a Low Platform Without Going on the Crowded Pier. Storage Battery Trucks Take the Freight From the Narrow Receiving Platform Directly into the Steamship. Time and Space are Thereby Saved

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There are in America alone several billion dollars' worth of pier sheds fairly new and in no danger of going to the scrap heap because of the advent of the overhead telpherage system. It is toward the better utilization of present pier sheds that this discussion is directed.

Harbor improvement is usually taken to mean the building of more piers. Though more piers are sometimes needed, it would be far more desirable, from every standpoint if freight could be handled 20 percent more rapidly on existing piers than to have 20 percent more piers built. The interest on investment, the depreciation, obsolescence and operating charges on dredged docking space, ships, piers and cargo (both inbound and outbound) are simply astounding. If the business could be handled in such a manner that even a small reduction could be made in the time the ship remains at the pier the financial returns would be enormously increased. Practically no consistent study has been made toward better utilization of existing waterfront equipment. Any manager who will give careful thought to the more rapid and economical handling of freight on his own piers may be assured that he will be well repaid for his effort.

The harbor crane of limited movement and the overhead telpher system limited to movement on tracks do not satisfactorily solve our problems. There is now available, however, a new type of machinery capable of wide application. This is the electric freight-handling truck. Electric storage battery trucks of small size suitable for pier use are so new that pier superintendents have not yet placed them in service, where they could give very handsome profits on the relatively small investment required.

Consider the unloading of a ship if electric storage battery trucks are used on the pier. The sling load of material, swung from the ship's side by burtoning, is lowered directly onto the back of an electric freight truck of 2 tons capacity. The electric truck moves the whole sling load of material away from the side of the ship and another electric truck immediately comes into position to receive the next sling load. A small number of electric trucks is enough to relieve the weakest link in the chain, which in the past has been the limited space on the pier immediately opposite the hatch. A pier manager, with an equipment of electric storage battery trucks, can safely offer to take the material away from the side of the ship as fast as the men on the inside of the ship can send the freight over the side of the ship.

There is no necessity for smashing up valuable electric trucks by dropping heavy articles out of a sling onto a truck waiting to receive the sling load. The drivers of these electric trucks have their machines under such nice control that they can easily wait a short distance away from the side of the ship until the sling load is lowered to within a few feet of the pier floor. The driver then comes forward with his truck, receives the sling load, and immediately moves away from the side of the ship, carrying the sling and all. On some commodities it is possible to take two sling loads to one truck load, so that the electric truck waits until a second sling has come over the side of the ship.

Sorting into many marks is, of course, the bane of rapid and economical freight handling. The sorting is, however, no worse with the use of electric trucks than it is without the electric trucks. There is a tremendous advantage with the use of the electric truck, in that the sorting is transferred away from the side of the ship where there is danger to workmen because of falling packages. The sorting is done where there is an unlimited amount of room with no danger to stevedores.

In every cargo there are certain large marks which can be sent out of the ship in complete sling loads. These sling loads of one mark can be moved by the electric truck directly from the side of the ship to the proper pile on the pier. Even for those marks in the ship which are not of large size, it is frequently possible to handle the work inside the ship in such manner that some sorting can be done on the inside, so that slings are sent up of one mark only or, at most, two marks in a sling. The sling load of two marks can be handled economically with the electric truck, as it is only necessary to deliver to the proper pile material from mark one and then run the truck to the pile of mark two. With an electric truck capable of short turning radius, movement on the pier is so easy and rapid that it is cheaper to run two separate piles with an electric truck carrying a whole sling load than to have stevedores carry the freight, package by package, to the proper piles.

The electric truck is especially advantageous in moving material through long distances, such as when delivering freight from the side of the ship to the "farm" at the shore end of the pier, or direct to warehouses. On such work the electric truck can do the trick more cheaply and far more rapidly than it can be done with mules. There is an especially great advantage, in that the electric truck can be maneuvered in such a manner that it can come to the side of the ship to receive a sling load without any delay whatsoever. Mule-drawn trucks have a large turning radius, and it is impossible to back the ordinary truck when using a mule. The result is that mule trucks must be pushed by hand up to the side of the ship to receive freight, causing very serious delay to the whole job and an expensive operation, because of cost for stevedores, mules and drivers.

Another advantage of the electric truck is that it can be run directly over platform scales for weighing the freight as it comes from the ship. Electric trucks can be driven so accurately and rapidly that they can be taken to a dormant scale at some point on the pier with almost negligible cost for running the distance required to get to the scale. It is not feasible to drive mule trucks over a scale, for the reason that the trucks are very inaccurate in the direction of their movement, and they cannot be stopped accurately because they have no brakes. When electric trucks are regularly used on a pier, it is advisable to have a number of portable platform scales which can be placed at any point desired. These scales are about 15 inches high from the pier floor, and are reached by an inclined plank from either end. The electric truck simply runs up the plank incline, stops a moment on the scales while the weight is taken, and proceeds to the pile, the freight car, the lighter or the warehouse. Portable platform scales of the type described cost but a small sum, and they will weigh freight in truck loads of 2 tons more accurately than the weigh masters' beam so commonly used by merchants and by the United States customs officers.

In European harbors it is not unusual for 60 percent of all the freight taken from a steamship to be handled directly from ship to freight cars without ever touching the pier floor. Freight cars in England and Continental Europe are, however, very commonly of the open type, using tarpaulins for rain protection. Cranes swing the freight direct from the ship to the open cars. In America, where much of the material must be weighed, either for purposes of the merchant or for the customs officers, the electric truck and the portable platform scale can be used very cheaply between the ship and the freight car. If the railroad tracks are at the center of the pier, or at the end of the pier, we can transfer package freight between the ship and the railroad box-car by use of the electric truck, without having to build new piers and new pier sheds for telphers and without having to install harbor cranes. There are real advantages in having a pier shed built out to the side of the pier. Most of the pier is then protected from weather at all seasons, and there is less danger of freight being damaged by rain than if there were a wide open space between the side of the ship and the pier shed, as usually found on European piers using harbor cranes with exposed railroad tracks on the outer edge of the pier.

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When loading a ship by electric trucks the operations are almost exactly the reverse of those described above for unloading. The sling is laid on the back of the truck as the truck stands beside the pile of freight on the pier. Freight is piled onto the sling, and the sling load made up completely, with the rope looped through, before the electric truck leaves the pile. When the truck reaches the side of the ship all that is necessary is to put the hoisting hook into the loop of the sling rope and hoist away. The moment the draft leaves the back of the electric truck the electric truck moves out of position, so that there is no danger to the truck even if some of the heavy packages do fall out of the sling through a distance of 15 feet or more. By the arrangement outlined it is possible for a dozen or more sling loads to be made up simultaneously. Each sling load is assembled on the back of an electric truck so that the sling load can be moved from the pile to the side of the ship without congestion. There is no expensive interference due to crowding of workmen and there is no delay to the ship. The speed of loading the ship depends entirely on how many men can be placed in the hold of the ship to stow the material.

As a general thing, it may be said that if electric trucks are used ships may be unloaded as fast as the package freight can be thrown over the side of the ship, and they may be loaded with package freight as fast as material can be stowed inside the ship. The limitations of speed need not be on the pier. The only limitations to speed are those due to the nature of the cargo and the number of men that may be used inside the ship for handling that cargo. A satisfactory electric truck must,of course, have a very short turning radius. It must have great flexibility of control and it must be built for rugged work.

Taking into account the incidental gains due to the increased volume of work which may be obtained from ships and from steamship piers, electric trucks of the type described can save on the average busy steamship piers a sum of money which is a princely return on the investment in trucks. The day of the electric dock truck has dawned and is already bright with achievement.

LIST OF BOILER MANUFACTURERS.—The Supply Men's Association of the American Boiler Manufacturers' Association has recently compiled and published an authentic list of the boiler, tank and stack manufacturers and steel plate users of the United States and Canada, in neat booklet form, which is now ready for distribution. Manufacturers of boiler materials, boiler manufacturers' supplies, tools, etc., can secure copies of the book for the sum of $3 (12s. 6d.) by addressing the secretary, Mr. F. T. Slocum, West and Calyer streets, Brooklyn, N. Y.

ANNUAL MEETING OF THE INSTITUTION OF NAVAL ARCHITECTS.—The annual meeting of the Institution of Naval Architects will be held in the Hall of the Royal Society of Arts, John street, Adelphi, W. C., London, on April 1, 2 and 3. The annual dinner will be given on Wednesday evening, April 1, in the Grand Hall, Connaught Rooms, Great Queen street, Kingsway, W. C.

Special Installation of an Electric Hoist on a Steamship Pier

About a year ago the Shepard Electric Crane and Hoist Company, New York, installed on Pier No. 80, North River, New York, for the Central Railroad of New Jersey an electric hoist, which has a rated capacity of 10 tons, for use in unloading heavy units of freight from cars on car floats. This hoist operates on 220-volt direct current supplied by means of flexible cable. This arrangement is rather unusual and was adopted in this case on account of the purchaser's desire to avoid bare wires on the dock.

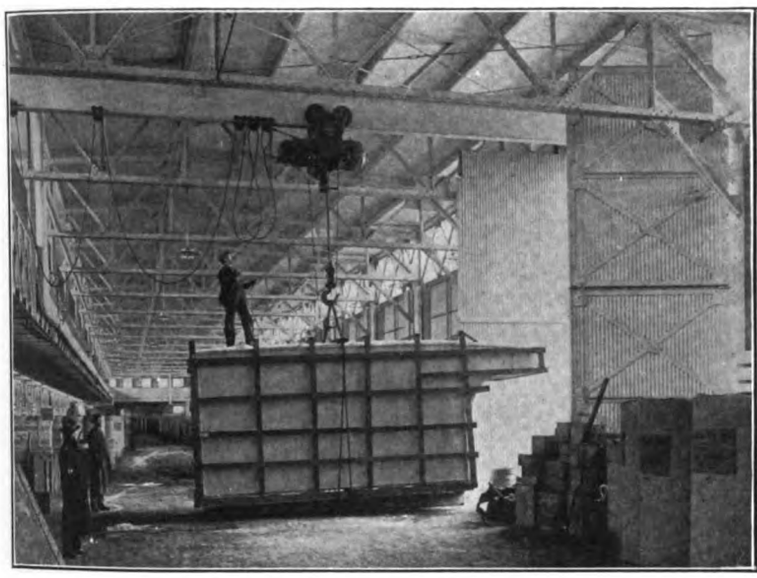

Fig. 1

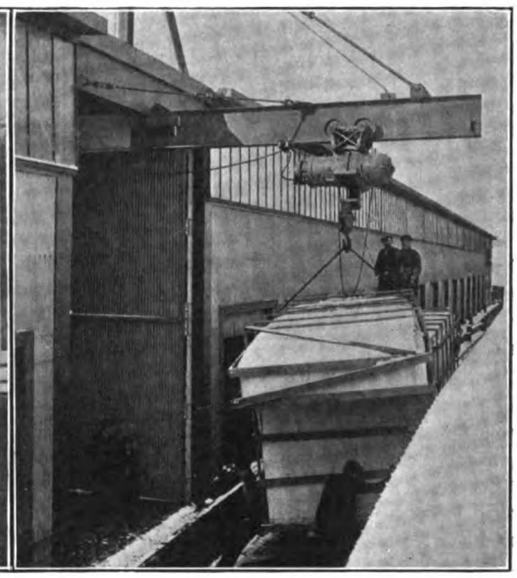

Fig. 2

An interesting feature of the installation is a jib projecting out over the car float. As can be seen from Fig. 2, this jib is hinged so that it can be brought to a vertical position when not in use and in this way avoid interference with vessels having standing rigging.

The method of raising the jib is unique in that it is accomplished by means of the hosting motion of the electric hoist itself. A steel cable is attached near the end of the jib and carried over a series of sheaves to a snatch block directly under the hoist when standing just inside the doorway. The ring on the end of this cable is thrown over the hoist hook and the jib raised by the upward motion of the hook. The cable is then firmly secured and the jib held in a vertical position. The lowering of the jib is accomplished by the reverse operation.

This hoist has been found to be very successful in service, due in a large measure to the complete protection afforded the gearing, brakes and bearings and the operation of these parts in baths of clean oil, completely protecting it from dirt and weather.

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River Terminals for Inland Cities

Unit Plan Proposed for River Terminals—Quay Construction, Sheds and Freight Handling Machinery Described—Unit Capacity and Costs

BY H. McL. HARDING*

At many river cities of moderate size, as upon the Mississippi and its tributaries, between the business portion and the water's edge, there often intervene railway tracks and the railroad rights of way. Between these tracks and the river usually there is available, including the levee, an area, the width of which is from 125 to 160 feet. On account of the convenience of these locations for shipping and receiving freight it is generally desired to establish here the industrial or local freight water terminal of the city.

In the sketch printed on page 113 are given the end and front elevations and the plan of a river terminal with a quay wall section. These are intended only to give the general idea of a river terminal and the relative positions of a few of the terminal elements to each other.

General Application

The plan secures a greater efficiency per lineal foot than is regarded possible with projecting piers, although this sketch should not be regarded as directly applicable to any particular locality, as modifications would probably be necessary.

To design any terminal correctly there would be required exact measurements, horizontal and vertical, a knowledge of the traffic conditions and the freight movements, and the character of what the wall foundation would consist, as well as the slope and width of the levee, and similar preliminary information upon which to base a correct conclusion and estimate.

Limiting Factors

This plan presupposes that there is here a width of about 150 feet. The tracks of the railroad company owning the right of way limit width extensions.

The terminal, if constructed in this space, must therefore conform to the land, which is limited in width, but the length can be extended in a direction parallel to the river.

City terminals, both for rail and water transportation, have such a marked influence on a city's growth and prosperity that nothing should be left undone to secure the best locations, which should be laid out according to correct plans and designs and to profit in equipping by the experience of others. The idea that for a progressive city a pile wharf is a terminal-asset or will add to the city's welfare should not be entertained.

Commerce Terminal

It is recommended that while there may be an industrial or local service terminal thus placed directly in front of the city, that some other location not so limited in space as this be selected for through or commerce freight, and that here, when the volume of the freight tonnage may warrant it, there be planned a large, complete terminal with its quay walls, its mechanical equipment, railway tracks, transfer and transit, sheds, warehouses, dray areas, classification and storage railway yards, industrial section, and connected with the all-important belt railway, which should have spurs leading to industrial works.

Terminal Investment Reimbursed

In not a few foreign cities large areas away from the city's center have been purchased, and that portion not needed for the terminal has been sold for industrial (chiefly manufacturing) purposes, at such an advanced price that the terminals, often requiring an investment of millions, finally cost such cities little or nothing.

Terminal Limitations

The greatly varied terminals are here represented as narrow and warehouses are not represented. This is due to the fact, as stated, that existing railway tracks and rights of way are close to the levees. The accompanying plan was designed with this limitation continually in view.

Warehouses

The warehouses should preferably be placed to the rear of the sheds and tracks, with overhead connections above the tracks; but where this is impossible they can be placed in a line with the sheds. There can be one warehouse in this case for each 600 feet; that is, one for each two units.

There should be a study therefore of each city frontage, so that the necessary modifications can be made.

Unit Lengths

The length of each unit is given as 300 feet, being a little longer than the longest river freight barge. It is better that 300 feet should be correctly designed, properly constructed and equipped, than that a greater length should be only partially completed, which would produce dissatisfaction of the shippers and consignees. In this 300-foot unit the shed may be made longer than given and wider if the land will permit, and there can result a changing of the proportions of space herein allotted.

Should there be sufficient room two railway tracks between the shed and the river may be added, making three tracks, and the arrangement of the rear tracks may be altered.

Lineal Foot Tonnage Capacity

It is not expected that 300 feet will be sufficient for a water frontage, as that length will only have a lineal transferring capacity during the seven months of from 30,000 to 45,000 tons, or from 100 to 150 tons per lineal foot. The next unit should be 300 feet more, extending along the levee, and each increase should be an additional 300 feet with shed and equipment.

The Unit Plan

By having a comprehensive plan in the beginning, the ultimate expense will be less, and all working parts will be interchangeable, and the machinery, consisting of a number of the cranes and transferring machinery, can be concentrated for quick loading or discharging service at any one unit.

If there should be only a small appropriation available for the terminal, the first 300 feet should be completed in every respect, and then the second unit can be added and equipped from a later appropriation. One thus completely equipped unit will be equal in capacity to two or even three units not so equipped.

There are, however, three types of these 300 foot-units, differing in first cost according to transferring and holding capacity and the character of the installation.

Costs Per Unit

The first type is illustrated in the sketches, and the average cost is about $100 (£33) to $200 (£41) per lineal foot, exclusive of the land, the railway tracks and the wall founda-

* Consulting and Designing Engineer, Freight Terminals, New York.

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tions, the cost of the latter being only ascertained through borings. These foundations may add considerably to the cost, depending upon the difficulty in securing a solid foundation.

QUAY WALL SECTION

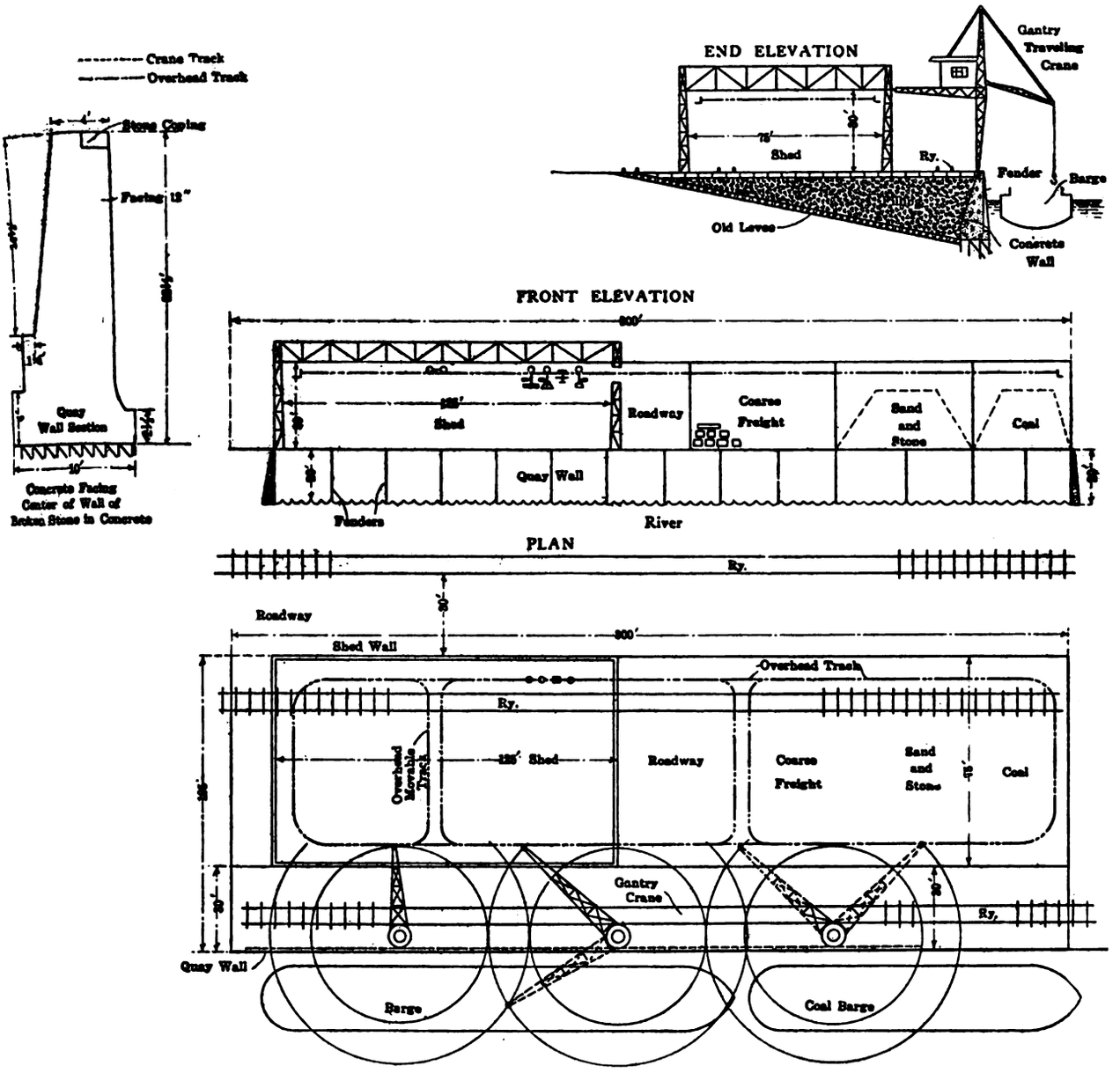
There is given in the sketch a cross section of a quay wall to be placed upon the foundation. The quay wall, where there is a firm natural support, and the height is 22½ feet, may consist of a gravity concrete wall 10 feet wide at the base, 4 feet wide at the top, with a slight batter, the dimensions as given varying according to the locality and the rise of the river.

The interior of the wall is of broken stone in concrete. There are between 5 and 6 cubic yards of concrete per lineal foot in the wall as shown, at an average cost of $8 (1/13/4) per cubic yard.

TRAVELING GANTRY CRANE

On the top of this wall is one of the tracks of the traveling gantry crane, the other track of the crane being attached just below the roof of the shed, as shown in the end elevation. This crane, as shown in different positions, transfers loads between the shed and the vessels or between the cars and the vessels, or between the coal or coarse freight areas and the vessel. This traveling gantry crane being elevated is superior to the locomotive crane, in that it does not occupy valuable quay surface and has more freedom of movement.

There is a railway track shown between the shed and the quay wall, besides the track within the shed and the one to the rear of the shed. The locating of the front track will depend upon the ease of approach, and in some cases trestles before the unit is reached may be required.



Sketch of Inland Navigation Terminal. Unit Length, 300 Feet. Width Limited

SHEDS

Thirty feet back from the water's edge is the shed, 125 feet long, 75 feet wide and 30 feet high below the cross girders. The shed, on account of high tiering, will have a holding capacity of about 2,000 tons of package freight. The tonnage of coarse freight in the open areas is not affected by the weather, and the bulk material is in addition to the 2,000 tons.

At one end of the shed is a roadway, and adjoining the roadway the open areas for coarse freight, bulk material, as coal, ore and sand. The relative positions of these can be changed.

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Within the shed are operated the fixed and movable overhead tracks, the tractor and carriage hoists. Upon the land side of the shed there are dray areas.

Great Range of the Machinery

The movable tracks, as well as the tractor and hoists, can pass over the coal and coarse freight areas, and with the crane can serve these open areas. For example, freight can be lifted from the barge by the crane, be burtoned to the carriage hoists and carried to and tiered upon any place within the shed or open space.

Similarly the reverse movements can be performed. Clamshell buckets attached to the gantry crane or carriage hoists can handle coal, ore, sand and other bulk material to and from the barges. Coal as well as other material may be reclaimed as well as deposited.

Freight can be taken between open cars or the platforms of closed cars and the vessels. All of the above movements are performed equally well in either direction by the machinery, smoothly, rapidly, economically and with the minimum of manual labor.

Increased Capacity Due to High Tiering

High tiering of package freight and high piling of coal, sand, etc., may be said to triple the storage capacity of the terminal.

In the front elevation, as drawn, which is parallel to the river, is the nearly vertical quay wall, the shed, the open areas and the longitudinal overhead tracks. It is urged that this view of the water front should be made architecturally pleasing, attractive and a credit to each city, even though the expense should be a little more. In this elevation the wooden fenders are outlined in front of the wall.

In the end elevation is the old-paved levee slope, the filling preferably pumped from the river channel, the paved surface of the quay, the shed, the crane and the transverse movable overhead track.

After the specifications for a location have been prepared and preliminary estimates received, exact figures and all details can be furnished. These should be a complete report for each city with complete specifications and full estimates.

Second Terminal Type

In cities of the intermediate class with a terminal of the second type, the dimensions are similar to those of the first class, but the quay frontage is of steel piling, the shed of more simple construction and there is less hoisting machinery.

The cost will be $120 (25/0/0) to $160 (33/6/8) per lineal front foot.

Third Type

The third class, for mere ports of call, consist of a wooden structure, simpler hoisting and conveying machinery, but no crane, a small, narrow shed, with only one track. The cost will be from $30 (6/5/0) to $50 (10/8/4) per lineal foot.

Total Terminal Costs

The total cost of a terminal depends upon the estimated tonnage to be transferred, which determines the number of units of 300 lineal feet. By the use of approved mechanical methods a greater tonnage (often double) can be transferred over a given lineal frontage than has been usually achieved in the United States. This would signify that the installation of such machinery would reduce the terminal investment for a given tonnage to one-half. That is, a terminal, correctly designed and equipped, if 900 feet in length, should be equivalent to one of 1,800 feet not equipped.

This advantage is in addition to the resultant economy also due to the freight-handling mechanism, besides the all-important fact that barges can be discharged and loaded in less than one-half the time usually consumed.

Conclusions

The following conclusions are inevitable:

1. That there must be a change from the old types of terminals, and from the former methods of handling the freight, to secure greater rapidity in the freight movement and economy in the operation.

2. That unless this rapidity and economy be secured most of the great potential advantages of water transportation cannot be attained.

3. That by serving by freight-handling mechanism, all space of the terminal, without rehandling, including loading, discharging and mechanical tiering, both rapidly and continuously, the desired results are obtained at properly designed and constructed terminals.

4. That the passenger traffic, as with the railways, is of less importance than the freight traffic, and where possible the freight and passenger traffic should be separated.

5. That where there cannot be free vertical movements of the freight, 50 percent more time will be required at a 50 percent additional cost. Hence the type of boat is of importance.

6. That the entire transference between barges and cars should be by machinery as well as the other terminal movements, as assorting, distributing and tiering.

7. Terminals should be designed to be constructed in units, and such that the maintenance should continue to be a minimum amount.

Gasoline (Petrol) Pilot Boat.—Three gasoline (petrol) boats have been built for the Isthmian Canal Commission by the Gas Engine and Power Company and Charles L. Seabury & Company, Consolidated, Morris Heights, New York City. Two of these boats are now in the commission's service at Panama, and the third has just been completed. These boats are of the open type, especially designed for pilot service in rough water, with a slightly curved bow, a full underbody and a "whaleboat" type stern. The length overall is 35 feet, the beam 7 feet 6 inches, and the draft 3 feet. Propulsion is by a 4-cylinder, 4-cycle, 6-inch by 6-inch Speedway motor of 38-48 horsepower, which gives the boat a speed of 10 knots. Forward the boat is decked over for a length of 13½ feet, forming a safe and comfortable landing stage for the pilot. Aft is a cockpit 11 feet long, while between the cockpit and the forward deck is the motor compartment. A gasoline (petrol) tank of 125 gallons capacity is placed between watertight bulkheads forward of the motor. There is also a large storage space forward of the tank.

Cantilever Crane for Lumber Dock

On the shipping docks of the Hammond Lumber Company, Astoria, Ore., are installed two 5-ton Brownhoist cantilever cranes for loading and unloading lumber vessels. A general view of the company's piers is shown in Fig. 1. There are in all two piers, each 450 feet long and 140 feet wide. About seventy million feet of lumber is shipped from these docks each year. The crane in the background of Fig. 1 has been in operation several years, while the one in the foreground is a newer type, having been in operation only one year. The lumber is delivered to the dock from the mills on two tram machines, and is distributed over the dock by the cantilever cranes to await shipment. The cantilever cranes are electrically operated and travel the entire length of the face of the dock at a speed of 400 feet per minute with a full load of 5 tons.

As can be seen from Fig 2, the crane consists of pier construction with traveling trucks and with a cantilever extension on each side covering the entire width of the dock. A Brownhoist man-trolley travels crosswise on a runway along

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Fig. 1.—Shipping Docks of the Hammond Lumber Company, Astoria, Ore., Equipped With Cantilever Cranes

these two cantilevers at a speed of 250 feet per minute with full load. A lumber unit of 5 tons is hoisted at the rate of 50 feet per minute. The trolley and the entire crane is operated by the man in the trolley cage.

The lumber is installed in sling loads of approximately 3,000 feet each. The crane is equipped with a platform containing six traveling endless chains, as shown in Fig. 2. This allows eight units to be put on the crane at one time, and the traveling chains carry the different units beneath the trolley, where they are picked up and put upon the dock.

The lumber is loaded into the ships by the ship's windlass, and the crane is equipped with a hinged apron, which can be extended over the ship so that the trolley can load the lumber direct into the vessel or the apron can be raised to allow the boats to dock. At the present time, the ship's windlasses are used for loading at the docks, because the receiving end is not yet equipped with unloading machines.

The crane shown in Fig. 2 will load 300,000 feet of lumber per day. At the base of the crane boom there is a platform on which 24 tons of lumber can be loaded and transported by the crane at the designed speeds. The lumber is piled on the dock to a height of 20 feet, which allows much more storage than is possible when hand labor is used. There is also a great saving in the wear and tear of the dock by the elimination of the teams. When teams were used in carrying lumber from the dock, it required from 6,000 to 10,000 feet of lumber per month for the dock upkeep, the elimination of which is no small saving.

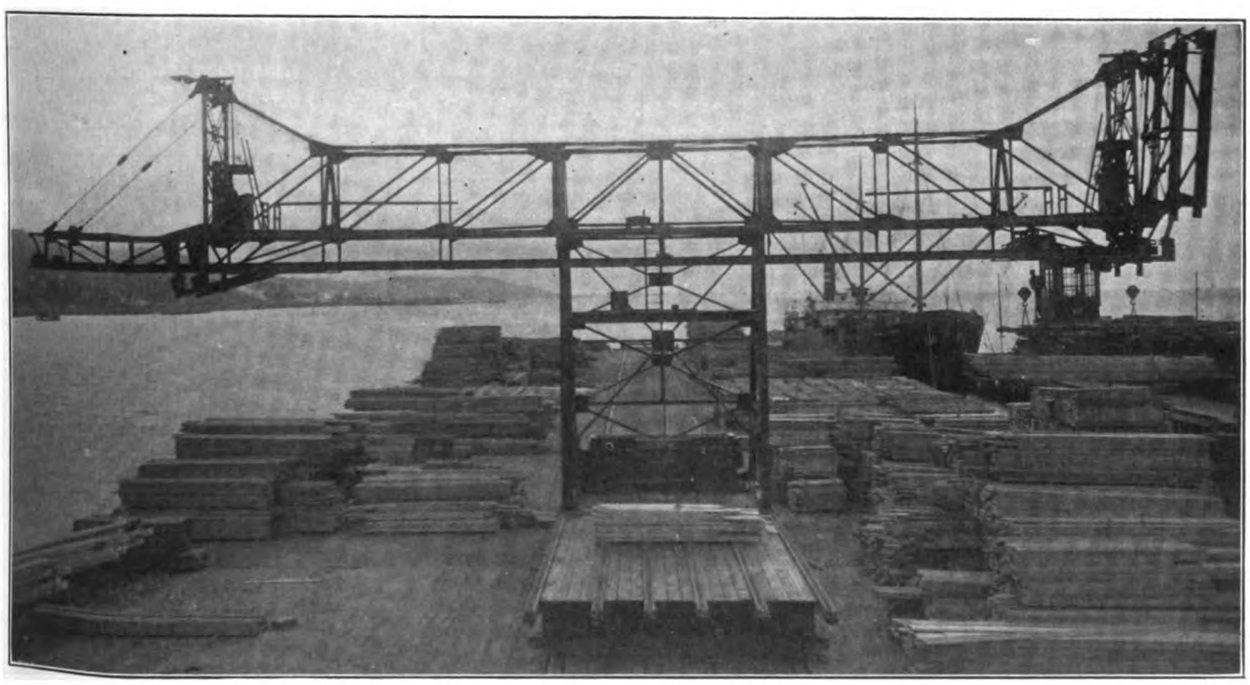

Fig. 2.—Special Type of Cantilever Crane for Handling Lumber

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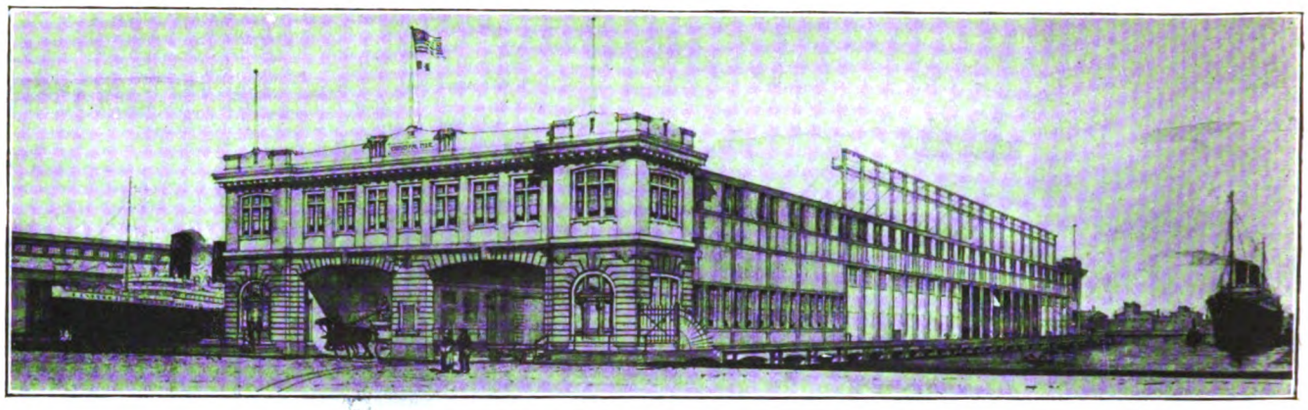

Fig. 1.—General View of New Municipal Pier in Philadelphia

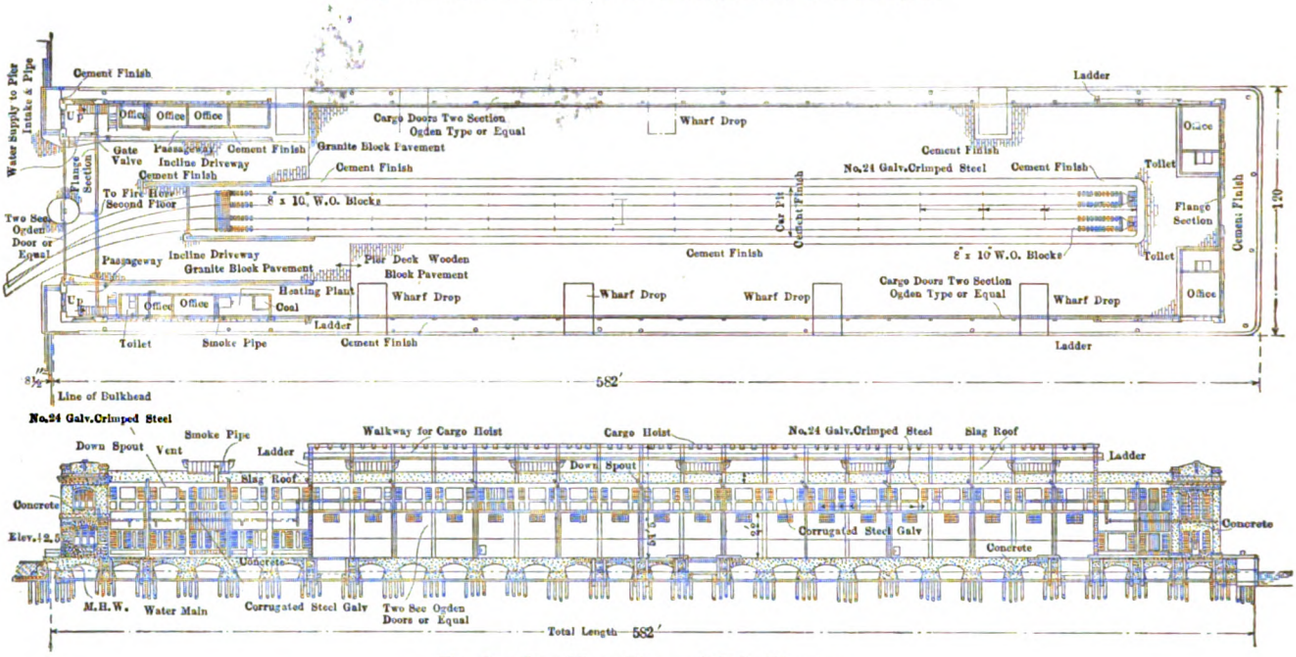

Fig. 2.—First Floor Plan and Side Elevation

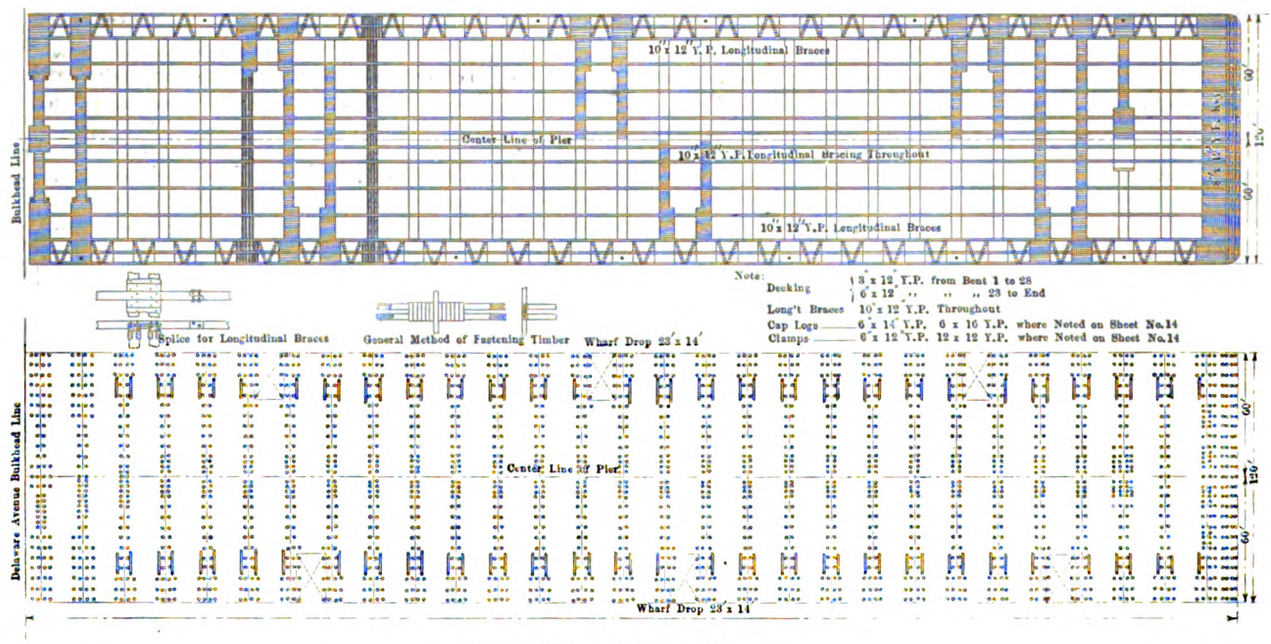
Bulkhead Line
10" x 12" Y.P. Longitudinal Braces
Center Line of Pier
10" x 12" Y.P. Longitudinal Bracing Throughout
10" x 12" Y.P. Longitudinal Braces
60'
120'
60'
Note:
Decking 3" x 12" Y.P. from Bent 1 to 28
6" x 12" " " " 23 to End
Long'l Braces 10" x 12" Y.P. Throughout
Cap Logs 6" x 16" Y.P. 6" x 16" Y.P. where Noted on Sheet No.14
Clamps 6" x 12" Y.P. 12" x 12" Y.P. where Noted on Sheet No.14
Splice for Longitudinal Braces
General Method of Fastening Timber
Wharf Drop 23' x 14'
Delaware Avenue Bulkhead Line
Center Line of Pier
60'
120'
60'
Wharf Drop 23' x 14'

Fig. 3.—Pile and Timber Construction

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New Municipal Pier in Philadelphia

Large Steamship Pier Erected in Philadelphia to Relieve Congestion in Shipping—Construction of the Pier and Facilities for Handling Freight

A new municipal pier, costing about $335,000 (£68,700), was opened recently at the foot of Dock street, Philadelphia, Pa. The pier is 582 feet long by 120 feet wide and is located in the center of the present shipping district for the purpose of relieving the congestion at this point until other steamship terminals are erected in the southern section of the harbor.

The substructure of the pier is of the timber pile and concrete cross wall type. The piles are cut off about 2 feet above the mean low water level and clamped, capped and decked in bents upon which are placed solid concrete cross walls. The sides of the superstructure are concrete walls with arched bays and the dock is designed to carry a load of 600 tons per square foot. It is paved with wood blocks and two types of Hassam pavement.

The superstructure is a single-story shed of steel, reinforced concrete and corrugated iron construction. It is 106 feet wide, leaving a working space of 7 feet outside of the superstructure on each side. The sides of the superstructure are of the open type, equipped with Ogden steel folding doors in every panel except for a few bays at each end of the structure. At the in-shore end of the pier is a second floor to accommodate the officers of the several steamship companies using the pier.

In the center of the pier is a depressed double car track, which has a capacity of 22 cars and allows freight to be trucked into the cars without a lift. At the in-shore end the deck has two inclines—one on either side of the car tracks—to allow wagons to enter the pier.

The freight is handled from the ships by elevated cargo beams, located above the roof of the shed, to which the tackle may be attached for "burtoning" the cargo either from or into the vessels. Portable electric winches are provided on the pier deck to supplement the ship's tackle in handling cargo. Numerous wharf drops also allow the ships to unload through side ports when they are constructed in such manner as to be able to do so.

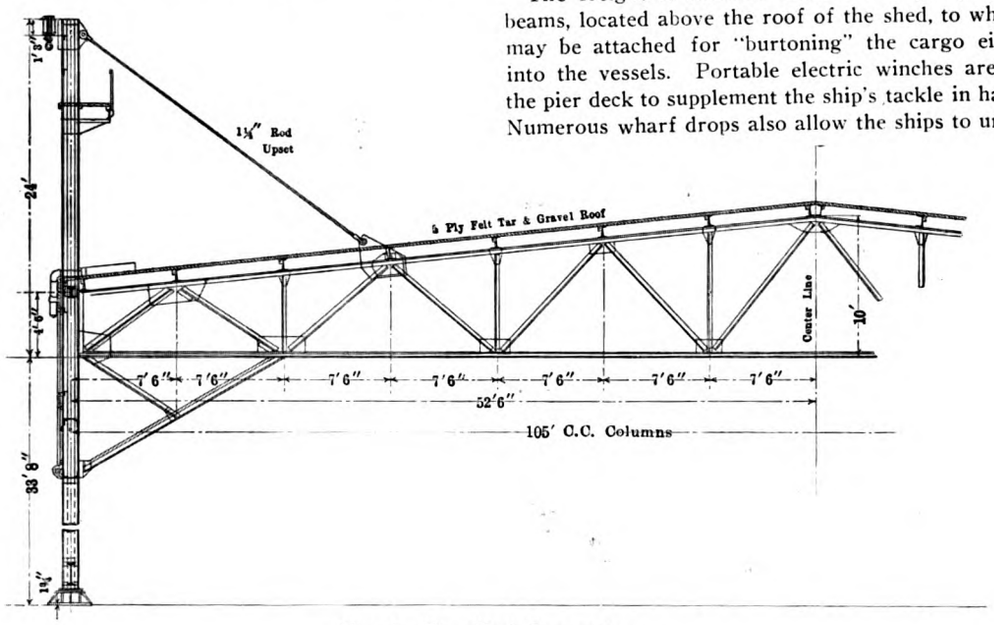

Fig. 4.—Pier Shed Construction

The northern half of the pier was rented before its completion to a newly formed corporation named the Philadelphia Piers Company, which is engaged in the general business of wharfage and stevedoring. Among other steamship lines they are at present handling all of the ships of the Austro-American fleet from Mediterranean ports. The other half of the structure will be reserved as an open pier for the present until the completion of additional municipal piers, accommodations being furnished to all comers in the order of their arrival or application for berthing space.

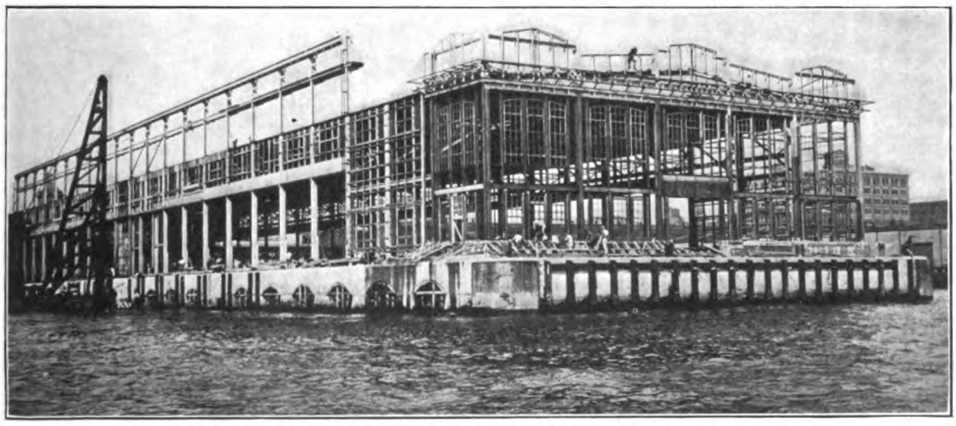

Fig. 5.—View of Pier Two Months Before Completion

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Electric Trucks on Steamship Piers

Some pertinent facts regarding the deplorable congestion of freight at New York docks were brought out in a recent issue of the *Commercial Vehicle*. It was pointed out that in handling freight at the steamship terminals along the west waterfront of New York City a tremendous loss of time occurs on account of inadequate facilities at the terminals. The cramped facilities are due primarily to the fact that the city had so rapidly outgrown its original plan that it has been impossible heretofore for the docks to keep pace with the the increase in traffic. The docks were originally designed for conditions existing at the time the majority of them were built. As the city has grown, the traffic in freight has increased steadily and relentlessly, while the facilities afforded on the riverfront are little it at all improved. Long ago outgrown, the water terminals are becoming year by year so dwarfed that the loss of time due to congestion seems to be reaching an almost critical stage.

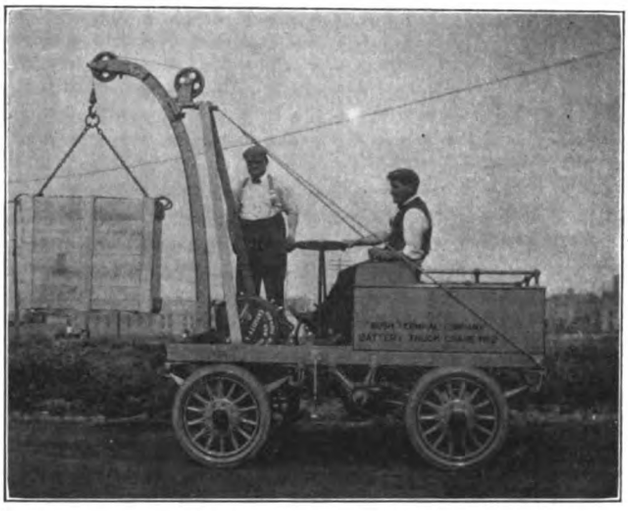

Fig. 1.—Elwell-Parker Electric Storage Trucks in Service on Steamship Pier

Fig. 2.—General Vehicle Company's Electric Trucks Handling Packages

The direction in which this condition can be remedied lies, it is claimed, in the provision of improved transportation appliances; in the fore rank among these appliances stand the commercial vehicle, the electric industrial truck, the overhead telpherage system of freight moving and the gravity conveyor. Of these appliances, it is maintained, the motor truck must assume the premier position as the connecting link between the dock and the merchants.

By more thoughtful arrangement of incoming and outcoming freight at the terminals the transportation agencies can relieve the congestion and make it possible to handle more business and do it more economically. One company, the New England Steamship Company, realizing the value of better facilities for handling freight, has so far solved the problem at their end that practically no loss of time is necessary. This has been brought about by the use of electric industrial trucks or electric stevedores, as they are sometimes called, and the fact is significant that, while there is probably no other dock in New York handling the volume of business of this one so free of congestion, nevertheless, with less street frontage, it handles 50 percent more tonnage per day than another well-known dock in its immediate neighborhood. The unloading platform force is greatly reduced by the introduction of the electric industrial truck, and the expense of maintenance is not high. The New England Steamship Company has twenty-one of these trucks, nineteen of which are of one-ton capacity, whereas the others are of two-ton capacity.

Fig. 3.—Battery Truck Crane Made by the General Electric Co.

Each one of these industrial trucks has displaced five men, whose wages were each $3 (12s. 6d.) per day. In this respect alone these trucks are saving their owners $63 (£13 2s. 6d.) per day, or a total of $18,900 (£3,880) per year. In addition to this saving the economy of time effected by these vehicles is incalculable. A small truck with a crane for lifting heavy weights is a valuable feature of these trucks, as it performs valuable service in lifting pieces of machinery and other heavy goods.

A further instance where congestion has been relieved by a rearrangement of the methods of handling incoming and outgoing freight is cited in the case of the Old Dominion Line, where a novel system of receipt and delivery of goods from the street has been adopted. One of its platforms is fitted with overhead chutes leading from the floor above, from which goods are received by the trucks or wagons after they have discharged their loads on the street-level platform. A truck having an outcoming shipment and an incoming consignment may back up to one platform, discharge the outgoing load and receive the incoming load without moving. The gangs which handle the goods are separate and distinct, being on different floors. The platform space required for the two operations is practically cut in two, and the frontage of the dock is about half that required under the old system. The pier is used solely for the transfer of cargo to and from the ships. All incoming cargo as taken from the ship is sorted; that for transfer to railway floats, lighters or other ships is held on the lower level, while that for city delivery is lifted to the loft by escalators.

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Further evidence of the greatly increased efficiency resulting received 30 cents (1s. 3d.) an hour, 50 cents (2s. 1d.) an given in a recent issue of the *Railway Age Gazette*. One instance cited referred to the use of eight electric trucks on the Cunard Line piers in New York, which, with eight operators, replaced a force of thirty-two handtruckers. The laborers received 30 cents (1s. 3d.) an hour, 50 cents (2s. 1d.) an hour after 6 P. M., and 60 cents (2s. 6d.) an hour on Sundays. The labor saving occasioned by the use of the eight trucks for the first day's work of nine hours was $87.60 (£18 5s. 0d.), or $1.22 (5s. 1d.) per truck per hour. With a long haul this can be increased, amounting in one case to as much as $2.64 (11s. 0d.) per truck per hour.

At another steamship pier electric trucks are in use in unloading cargoes of wine, the vessels usually bringing 6,000 to 8,000 50-gallon barrels. Each sling hoists three barrels which, under the old method, were dropped on the pier and rolled several hundred feet to the bulkhead by laborers stationed a short distance apart. With the electric trucks the barrels are dropped on a small portable platform, from which six barrels are tipped on to each one of the trucks and carried to the stowing place. The seven trucks installed here handled an average of 547 barrels per hour, each barrel weighing about 500 pounds, at a saving of labor of $8 (£1 13s. 4d.) per hour.

At another pier coastwise steamers were discharged by the use of these trucks at an average saving in the cost of handling barrels, boxes and case goods of 10 cents (0s. 5d.) per ton. In this case freight was trucked from the hold of the vessel through side cargo ports and stowed on the pier. At another point, where the operation was similar to the last case mentioned, but where the labor rates are very low, the average saving compared with hand trucking made by each truck in the first six months' service was $600 (£125), or $100 (£20 16s. 8d.) per month per truck.

The electric truck has been used at various points for handling steamship freight with very large resulting economies. Where freight is trucked in and out of the ship through side ports, as is the case with a good many coastwise vessels, the trucks can run directly in and out of the vessel. Where freight is handled in and out of the vessel's hatches in sling loads by means of hoisting machinery, as is customary with the larger vessels, the trucks can deliver to or take from the slings a complete load. These loads can be made up on the truck when loading and be carried away at a single trip when unloading.

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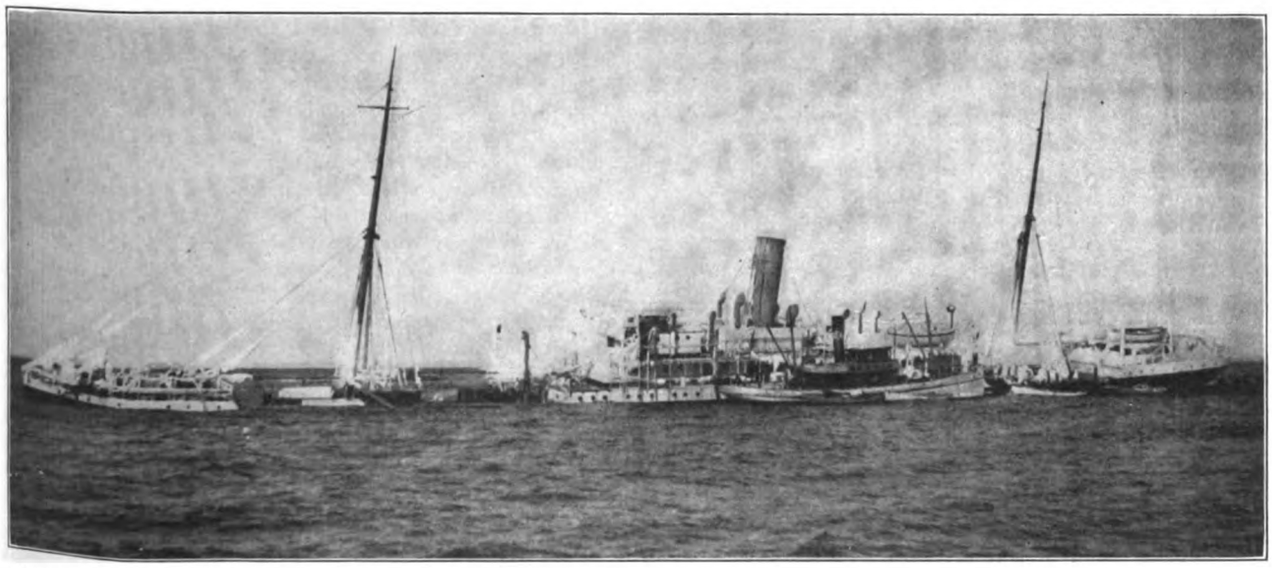
Crumpled Bow of the Steamship *Nantucket* after Collision with the *Monroe*

Damage to the Nantucket

In the *Nantucket-Monroe* collision, which occurred on Jan. 30, resulting in the immediate sinking of the *Monroe*, with the loss of forty-one lives, the damage to the *Nantucket* was confined to the bow of the vessel. The above photograph gives some idea of the extent of this damage, as well as of the force with which the ships collided.



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Wreck of the Royal Mail Packet Company's Steamship *Cobequid* on Trinity Rock, Six Miles off Port Maitland, N. S.

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McAndrew's Floating School

BY CAPTAIN C. A. McALLISTER*

CHAPTER XX

Examination Questions and Answers

Since the last lecture to his class McAndrew had been so busy with his regular duties that nearly a month had elapsed before another opportunity offered to give the boys in the Floating School further instruction. In the meantime the four young men had continued their studies, using such text-books as they had on hand for the purpose. It seems that Pierce, who was somewhat more ambitious than his shipmates, had, at about the time that the Chief commenced their instruction, enlisted as a student in one of the large correspondence schools and taken up its course in marine engineering. The text-books furnished with the course were very comprehensive, and Pierce had kindly loaned them to his fellow students, so that all had profited by studying them.

McAndrew commenced his remarks by saying, "We have now covered, in a somewhat brief manner, to be sure, nearly all the principal subjects necessary for an elementary understanding of marine engineering. It is now up to you to put in practice some of the things I have told you. To get your 'tickets' as assistant engineers is, of course, your ambition. The best way to prepare for your examination for a license is to work out some of the questions which have been asked by the steamboat inspectors. The existing laws in the United States concerning licenses are somewhat vague in regard to examinations, and I will quote you the following extracts from the statutes, which will be of interest to you:

"'No person shall receive an original license as engineer or assistant engineer who has not served at least three years in the engineer's department of a steam vessel. * * *

"'Any person who has served three years as apprentice to the machinist trade in a marine, stationary or locomotive engine works, and any person who has served for a period of not less than three years as a locomotive or stationary engineer, or any person graduated as a mechanical engineer from a duly recognized school of technology, may be licensed to serve as an engineer of steam vessels after having had not less than one year's experience in the engine department of steam vessels, a portion of which experience must have been obtained within the three years preceding his application, which fact must be verified by the certificate in writing of the licensed engineer or master under whom the applicant has served, said certificate to be filed with the application of the candidate; and no person shall receive license as above, except for special license, who is not able to determine the weight necessary to be placed on the lever of a safety valve (the diameter of valve, length of lever, distance from center of valve to fulcrum, weight of lever, and weight of valve and stem being known) to withstand any given pressure of steam in a boiler, or who is not able to figure and determine the strain brought on the braces of a boiler with a given pressure of steam, the position and distance apart of braces being known, such knowledge to be determined by an examination in writing, and the report of examination filed with the application in the office of the local inspectors, and no engineer or assistant engineer now holding a license shall have the grade of the same raised without possessing the above qualifications. No original license shall be granted any engineer or assistant engineer who cannot read and write and does not understand the plain rules of arithmetic.'

"So far as the letter of the law is concerned it would seem to be very easy for you to get a license, providing you can solve the two problems called for in the above qualification. But do not fool yourselves by thinking that you can get away with a ticket so easily; while the law on the subject is very old and not brought up to date, you will find that the examiners are very much alive to present conditions. While the law requires satisfactory answers to only those two questions, it does not prohibit further questioning by the inspectors, and if you ever pass your examinations you will find that you must be pretty well posted in about every subject connected with the business."

"Chief," inquired O'Rourke, "I see that you can get a ticket inside of a year if you are a graduate—how about graduates from our school?"

"I am afraid," replied McAndrew, "that our little school here would not score very heavily as a 'recognized school of technology'; but do not be alarmed about that. Where there is one licensed marine engineer who is graduated from a 'recognized school of technology' there are at least forty-nine who have graduated from the College of Practical Experience and Self-Help. This little Floating School of ours is simply a branch of that college.

"You will notice that the law requires that every candidate must understand the plain rules of arithmetic. I know that you all understand these rules, but I am not so sure that you all understand the plain rules of mensuration, or the measurements of area and volume. No one can pass the examination who does not understand these rules, so I will devote a few moments to explaining them to you.

MEASUREMENT OF AREAS AND VOLUMES

"To find the area of any plain rectangular figure, that is, one having four square corners, you multiply the length by the breadth. Thus the side of a rectangular tank 8 feet long and 4 feet wide will contain $8 \times 4 = 32$ square feet.

"To find the volume of a rectangular tank we must multiply the length, breadth and depth together. Thus if the above tank is 4 feet in depth it will contain $8 \times 4 \times 4 = 128$ cubic feet.

"A circle is defined as a figure every point of whose circumference or boundary is equally distant from a point within called the center. You are familiar with how it is drawn with a pair of compasses. The diameter of a circle is the length of a line drawn across it and through its center. To find the length of the circumference, or distance around the circle, we multiply the diameter by the figures 3.1416. Thus if the diameter of a barrel is 2 feet, the circumference will be 2×3.1416, or 6.2832 feet.

"You will very often be required to find the area of a circle; the way to do it is to square the diameter; that is, multiply it by itself, and then multiply the quotient by the figures .7854. If you are told that a high-pressure cylinder is 30 inches in diameter, to find its area you first multiply 30×30, and get 900. Then $900 \times .7854 = 706.86$ square inches, the area.

"You must always remember those two 'constants,' as they are termed, 3.1416 for the circumference and .7854 for the area of a circle, as you will often have use for them when you do not have time to hunt them up in the text-books."

"I can remember them," said O'Rourke. "It's just as easy as remembering 4-11-44."

"Yes, and much more useful," said the instructor.

"It is also quite important for you to know how to find

* Engineer-in-chief, U. S. Revenue Cutter Service.

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the volume and area of a cylinder. For example, if you are going to cover a tank with asbestos, you would want to know how to find the total area. A cylinder, you know, is a figure which if cut across perpendicular to its axis at any point between the top and bottom will be circular in section. Hence if we have a cylindrical tank 5 feet in diameter and 10 feet high, and wanted to know how much material was needed to cover it all over, we would first find the circumference of a circle 5 feet in diameter, which is $5 \times 3.1416 = 15.708$ feet. Multiply this by the height, 10 feet, and we have $10 \times 15.708 = 157.08$ square feet to cover all around the sides.

"How would you find the amount of covering for the ends, O'Rourke?"

"Multiply her by .7854," replied the young man.

"Multiply what?"

"Why, the 5 feet diameter, of course," confidently said O'Rourke.

"There's where you're wrong, as usual. I told you that in order to find the area of a circle you must square the diameter. So we have $5 \times 5 = 25$ and $25 \times .7854 = 19.635$ square feet as the area of one end. But there are two ends, so we must allow for twice that, or 39.27 square feet. This added to 157.08 gives us 196.35 square feet as the total surface of the tank.

"It is of equal importance for you to be able to find the volume of a cylinder, or how much it will hold if it is hollow, or how large it is if solid. For example, we want to know how many gallons of oil or water a tank like the above will hold. To do this we must first find the area of the circle, which from the above we know to be 19.635 square feet, and as it is simpler to calculate it in inches we multiply this number by 144, or $19.635 \times 144 = 2827.4$ square inches. Right here I want to warn you against a mistake that so many beginners fall into; that is, of multiplying feet by inches. Remember, feet must always be multiplied by feet and inches by inches, or your answer will be wrong. Hence the height or depth of this tank being 10 feet, we must use 10×12, or 120 inches, as the multiplier. Then we have $2827.4 \times 120 = 339,288$ cubic inches as the volume of the tank. There are 231 cubic inches in a gallon, so we divide the total number of cubic inches in the tank, 339,288 by 231, and we find in even numbers that the tank will contain 1,469 gallons.

"There are not many spherical surfaces around marine machinery, but it might be useful at some time for you to know how to find the volume and surface of a sphere or ball. This is defined as a solid bounded by a curved surface, every point of which is equally distant from a point within known as the center. Any line through the center and cutting the surface is the diameter. We will suppose that we have a ball float in the feed tank 12 inches in diameter, and want to know how much sheet copper it will take to make such a float. The rule is to square the diameter and multiply by our old friend 3.1416. Thus $12 \times 12 = 144$ and $144 \times 3.1416 = 452.39$ square inches as the surface of the ball. Now if we had a cast iron ball 6 inches in diameter hanging on a safety valve lever, and wanted to know its weight, we would first find its volume in cubic inches. To do this the rule is to cube the diameter; that is, multiply it by itself twice, and multiply that product by .5236. Thus in this case it would be $6 \times 6 \times 6 = 216$, and $216 \times .5236 = 113.1$ cubic inches in the ball. Knowing that cast iron weighs .26 pound to the cubic inch we multiply 113.1 by .26, and find that the ball weighs 29.41 pounds."

"Chief, could you use that rule to find the weight of a highball?" inquired O'Rourke.

"From all I can hear of the subject highballs haven't much weight, as their general tendency is to make you light-headed," suggested McAndrew.

Safety Valve Problems

"Now we are ready for the all-important safety valve problem, and I am particularly anxious to have you understand the principle upon which it is worked, rather than to learn some particular example, as is too often the case with beginners. When you come up for examination you will find that the conditions given you will be entirely different from any problem you may have worked out. The following is an outline sketch, which will enable you to follow out the principle involved.

"In Fig. 37, O represents the fulcrum, or point where the lever is hinged; V represents the valve; N the center of gravity of the lever; that is the point where, if the lever should be picked up in your hand, it would exactly balance and remain in a horizontal position. M represents the point where the weight W is located on the lever. The forces acting on the lever at M and N have a tendency to make it fall or rotate in a direction opposite to the hands of a watch. The weight of the valve and stem at S also has that tendency. The only upward force, or the only force tending to make the lever turn in the same direction as the hands of a watch, is the pressure of the steam on the valve V, operating on the lever at the point S. Now, safety valve levers are not supposed to be rotating in either direction, but to remain in

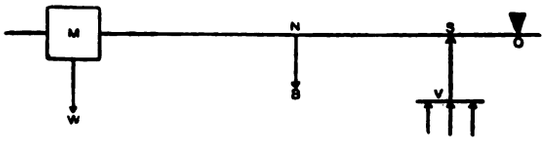

Fig. 37.—Safety Valve Problem

equilibrium, hence the downward forces must be such as to balance the upward force, and the only force that can be adjusted to bring them all in equilibrium is that of the weight W. This can be done either by varying the weight itself or by moving it out or in from the fulcrum O.

"The tendency to cause the lever to rotate about the fulcrum, with a ball of a given weight, varies with the distance the ball is from the fulcrum exactly as the principle of the levers, which I have explained to you before. To measure this tendency you multiply the weight by the distance from the fulcrum, and the product is known as the moment. Thus a weight of 1 pound, placed 4 feet from the fulcrum, would have a moment of 4 foot-pounds to cause rotation. Similarly, a weight of 4 pounds placed only 1 foot from the fulcrum would have the same moment of 4 foot-pounds. If the distances were given in inches we would speak of the moments in so many inch-pounds.

"To illustrate these principles, suppose in Fig. 37 we were given the following quantities:

Distance OS from fulcrum to center of valve 6 inches.
Weight of valve and stem 8 pounds.
Diameter of the safety valve 3 inches.
Steam pressure 50 pounds.
Weight of lever 10 pounds.
Center of gravity of lever 20 inches from fulcrum.
Distance of weight (OM) from fulcrum 30 inches.
Required, the size of the weight necessary to keep the valve in equilibrium when steam is at 50 pounds pressure.

"The upward tendency is represented by the pressure of the steam at S. A valve 3 inches in diameter has an area of 7.07 square inches; this, multiplied by 50, the pressure per square inch, gives us a total upward pressure of 353.5 pounds. But this is 6 inches from the fulcrum, so the moment will be $353.5 \times 6 = 2,121.0$ inch-pounds.

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"All the other weights exert downward forces and tend to affect this upward pressure, so we will have the following to work against the 2,121 inch-pounds moment of the valve.

"Weight of valve and stem (8 pounds) multiplied by lever arms (6 inches) equals 48 inch-pounds.

"Weight of lever (10 pounds) multiplied by distance O.V (20 inches) equals 200 inch-pounds.

"We do not yet know the size of the weight *W*, but we do know its distance from the fulcrum (30 inches), hence we add 48 and 200, and find the sum to be 248, and subtract it from 2,121 and find we have 1,873 inch-pounds to make the downward moments equal to the upward moments. This 1,873 is in inch-pounds, hence dividing it by 30 inches will give us 62.4 pounds as the size of the weight to maintain the balance.

"We will suppose that the weight (62.4) had been given us, and we were asked to ascertain what distance it should be located from the fulcrum in order to balance 50 pounds pressure on the valve. In this case we would have the same upward pressure from the valve, or 353.5 pounds, and the moment of 2,121.0 inch-pounds. The downward forces for the weights of the valve and stem and the lever will be represented by a total of 248 inch-pounds. As before, subtract this from 2,121 and we have 1,873 inch-pounds. Knowing the size of the weight in pounds (62.4) we divide it into 1,873, and find that the weight should be located 30 inches from the fulcrum in order to be in balance.

"Another way the problem might be given you is to find out what the steam pressure would be with all the conditions given as above. The downward pressures would be as before:

	Inch-Pounds
Valve and stem, 8 pounds × 6 inches	= 48
Lever, 10 pounds × 20 inches	= 200
Weight, 62.4 pounds × 30 inches	= 1,873
Total.	2,121

"We know that the area of the valve is 7.07 square inches, and its lever arm, or distance from the fulcrum, is 6 inches, so we have 7.07 × 6 = 42.42. As there is only the one force acting upward we divide 2,121 by 42.42, and find that a pressure of 50 pounds can be carried with the weight set in the position given.

How to Figure the Stresses on Boiler Braces

"The next problem we will take up is the one required by law: 'to figure and determine the stresses brought on the braces of a boiler with a given pressure of steam, the position and distance apart of braces being known.'

"This is very simple, as it only involves multiplication. Thus if the braces are spaced 12 inches apart each way, and the steam pressure is 160 pounds per square inch, we multiply 12 by 12, and find that there are 144 square inches to be supported, and 144 × 160 = 23,040 pounds stress which is brought on one brace. Similarly, if the braces are spaced 14 inches apart horizontally and 10 inches vertically, and the steam pressure is 160 pounds per square inch, we would multiply 14 by 10, and find that there is an area of 140 square inches to be supported by one brace, and 140 × 160 would give us 22,400 pounds, or an even 10 tons, as the total stress on one brace.

"The inspectors, however, do not confine themselves to this simple form of the problem, and you are liable to get one like the above, with the addition that they would ask you the safe diameter of the brace. To perform this we must know the United States rules as to the safe working load per square inch of section. These rules give allowances of 6,000 pounds per square inch of section for iron; above 5 square inches sectional area if steel is used and regularly inspected an allowance of 8,000 pounds per square inch is made; braces above 1¼ inches diameter are not allowed to exceed 9,000 pounds per square inch of section if such stays are not forged or welded.

"You might get a question similar to the following: What diameter of bracing should be used to support a flat surface 12 inches by 12 inches, using steam at 200 pounds pressure? The solution would be 12 × 12 = 144, and 144 × 200 = 28,800 pounds to be supported; 28,800 ÷ 9,000 = 3.2 square inches. Looking at a table of areas we would find that a stay having a diameter of 2 1/16 inches has an area of 3.341 square inches, which is the nearest area to the one we know to be necessary. Very likely these braces would be made 2⅛ inches in diameter, as that would be the nearest commercial size obtainable.

Allowable Working Pressure on a Boiler

"Possibly you will be asked how to find what pressure will be allowable on a Scotch boiler, knowing the thickness of shell, the diameter of the boiler, tensile strength of plate, etc.

"The United States Government rule is to multiply one-sixth of the lowest tensile strength in pounds by the thickness in inches, and divide by one-half the diameter, also in inches; 20 percentum is to be added if double riveting is used for the horizontal seams, which, of course, would be used these days; in fact, the seams would probably be triple-riveted, but the rule makes no allowance for that.

"For example, if we had a boiler 15 feet in diameter, made of steel plates, the lowest tensile strength of which was 60,000 pounds per square inch, and the shell was 1½ inches in thickness, and we wanted to find what presure would be allowed by the inspectors, we would proceed as follows:

15 feet × 12 = 180 inches diameter.
One-half of 180 = 90 inches.
One-sixth of the lowest tensile strength (60,000 pounds) = 10,000 pounds.
1½ inches = 1.5 inches.
10,000 × 1.5 = 15,000.
15,000 ÷ 90 = 166.6 pounds.

"As double riveting allowances must be made, we add 20 percent of this and have 166.6 + 33.4 = 200 pounds pressure allowable on the boiler."

"Chief," said Pierce, "suppose we wanted to find out what thickness to make this boiler shell, and we knew the size and pressure we wanted to carry?"

"We would simply reverse the operation," replied McAndrew. "In other words, multiply the radius in inches by the pressure in pounds and divide by one-sixth the tensile strength. Thus 90 × 200 = 18,000; 18,000 ÷ 15,000 = 1.2 inches thick. But for double riveting an allowance of 20 percent additional is made, and 1.2 is only 80 percent (100 — 20) of the thickness allowance. As 80 percent is 1.2, 100 percent will be 1.5 inches, the thickness which we will have to make the boiler shell in order to withstand the pressure required and conform to the rules.

"Strange to say, all the problems required by law to be given candidates for engineers' licenses in this country relate to boilers. These laws were passed in the early days of steam navigation, and I presume that the legislators in those days thought that if a man understood boilers thoroughly he could manage somehow to run the engines. Fortunately for the good of the service the inspectors ask questions concerning nearly all parts of the steam machinery, so it is well to be prepared in a general way."

(To be concluded.)

Launch of the Britannic.—The new White Star liner *Britannic*, a 48,000-ton triple-screw steamer, 885 feet long over all, was successfully launched at the Harland & Wolff shipyard, Belfast, on February 26. Propulsion of the vessel is by combination machinery.

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Lloyd's Summary of World's Shipbuilding

Comprehensive Returns from the Ship and Engine Building Firms of All Maritime Nations Show a Record Output for 1913

According to the annual returns of Lloyd's Register of British and Foreign Shipping, just published, which take into account only vessels of 100 tons gross and over which were launched during the year, the total output of the world during 1913 appears to have been 4,009,791 tons. The merchant tonnage amounted to 3,332,882 tons and the warship tonnage to 676,909 tons. The merchant tonnage shows an increase of about 431,000 tons over the returns for 1912. According to the latest advices from Lloyd's Register, the gross tonnage of vessels of all nationalities totally lost, broken up, etc., during the twelve months amounts to about 682,000 tons gross. The net increase of the world's mercantile tonnage at the end of 1913 is, therefore, about 2,651,000 tons. Steam tonnage has been increased by about 2,690,000 tons, while sailing tonnage has been reduced by 39,000 tons. The warship tonnage, amounting to about 677,000 tons displacement, exceeds the tonnage launched during 1912 by about 142,000 tons, and is the largest reached, with the exception of 1911, when the output was 92,000 tons higher.

SHIPBUILDING IN THE UNITED KINGDOM

During 1913, exclusive of warships, 688 vessels of 1,932,153 tons gross have been launched in the United Kingdom. The warships launched at both Government and private yards amount to 49 of 271,376 tons displacement. The total output of the United Kingdom for the year has, therefore, been 737 vessels of 2,203,529 tons. The output of mercantile tonnage in the United Kingdom during 1913 shows an increase of 193,639 tons on that of last year, and is the highest ever reached. As regards war vessels, the total is nearly 80,000 tons more than in 1912. Practically the whole of the tonnage launched has been built of steel, and over 99 percent is composed of steam tonnage.

Size and Speed of Vessels—The number of large steamers launched in the United Kingdom during 1913 has greatly exceeded the average of recent years. During the five years, 1908-12, 205 vessels of 6,000 tons and upwards were launched in the United Kingdom, showing a yearly average of 41 vessels; and of the total number, 57 were of 10,000 tons and upwards.

The returns for 1913 show that 84 vessels of 6,000 tons and above were launched. Of these, 21 were over 10,000 tons each, the largest being the Cunard liner *Aquitania*, of 47,000 tons, and the Allan line steamers *Alsatian* and *Calgarian*, 18,485 tons each. The following are the other vessels of 13,000 tons and upwards, viz.:

	Tons gross.		Tons gross.
Andes	15,620	*Tubantia*	14,055
Alcantara	15,600	*Gelria*	13,868
Orduna	15,600	*Alaunia*	13,450
Ulysses	14,491	*Andania*	13,405

Of the vessels launched in the United Kingdom 16 are capable of a speed of 16 knots and above. The fastest of these are the turbine vessel *Aquitania* and two other turbine steamers intended for service in the Irish Sea and for the English Channel, respectively, the three designed for a speed of over 20 knots.

Vessels Fitted With Turbines and Internal Combustion Engines—Four steamships, viz.: *Andes*, 15,620 tons; *Alcantara*, 15,600 tons; *Orduna*, 15,600 tons, and *Katoomba*, 9,424 tons, have been fitted with a combination of turbines and reciprocating engines. During 1913, including the vessels mentioned in the preceding paragraph, seven steamers were launched, with a total tonnage of 88,927 tons, which will have turbines only. The launches for the year also include three vessels of a total tonnage of 8,494 tons, with internal combustion engines, the largest being the *Arum*, of about 3,550 tons. In addition, 14 small vessels of under 300 tons each, also fitted with motors, were launched during the year.

Other Special Types—Of steamers building on the Isherwood system of longitudinal framing, 47 were launched during 1913, with a gross total tonnage of 276,233 tons. Including 31 of these vessels with a tonnage of 199,750 tons, there were launched during the past year 43 steamers of 237,548 tons for the carriage of oil in bulk. The returns also include seven vessels of other special constructional design; 117 steam trawlers and other fishing vessels; 25 tugs, besides a large number of dredgers, barges and other vessels designed for channel, river and other special services.

Output of Leading Ports.—The Glasgow district occupies the first place among the shipbuilding centers of the country, showing an output of 415,044 tons. Then follow Newcastle, 366,331 tons; Sunderland, 299,964 tons; Greenock, 269,743 tons; Middlesbro', 154,743 tons; Hartlepool, 153,071 tons, and Belfast, 129,081 tons. In warship tonnage Glasgow also leads with 66,803 tons displacement, closely followed by Newcastle, 65,737 tons, and Barrow, 54,400 tons.

Progress of Shipbuilding During the Year—As regards the movement of the shipbuilding industry during the course of 1913, Lloyd's Register returns show that at the opening of the year, irrespective of warships, 1,970,065 tons were being built in the United Kingdom. The returns for the March quarter indicated an increase of about 94,000 tons in the work in hand, thus recording the highest total ever reached. Since then a steady decline has taken place. The June returns showed a decrease of about 60,000 tons, and the September returns a further decrease of 16,000 tons. The amount of tonnage under construction at the end of December, although 107,000 tons less than the record figures of last March, is within 13,000 tons of the total building at the end of 1912. The total warship tonnage under construction in the country is now 604,801 tons displacement, as compared with 496,875 tons twelve months ago.

SHIPBUILDING IN OTHER COUNTRIES

Outside the United Kingdom there have been launched during the year 1,193 vessels of 1,806,262 tons, divided as follows: Merchant and other vessels, 1,062 of 1,400,729 tons; warships, 131 of 405,533 tons displacement. The figures for merchant tonnage show the very large increase of over 237,000 tons, as compared with those for 1912, and constitute a record. The leading places are held by Germany, 465,226 tons; the United States, 276,448 tons; France, 176,095 tons, and Holland, 104,296 tons.

The largest vessel of the year was the turbine steamship *Vaterland*, of about 56,000 tons. During 1913 thirteen vessels of over 3,700 tons each, to be fitted with internal combustion engines, were launched. Their aggregate tonnage amounted to about 66,800 tons. The figures for the year include six steamers of a total tonnage of 85,950 tons, to be fitted with turbines, and five 67,361 tons, which will have a combination of reciprocating engines and turbines. The output for the year also includes 27 oil-carrying steamers of a total tonnage of 129,400 tons.

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The total output of war vessels shows an increase of about 63,000 tons displacement on the figures for the preceding year.

Germany—The returns show an increase of 90,000 tons in the shipbuilding output as compared with last year, and the figures are easily the highest on record. The three largest were the Hamburg-Amerikan liner *Vaterland*, of about 56,000 tons gross, launched at Hamburg; the steamship *Columbus*, 35,000 tons, launched at Danzig for the Norddeutscher Lloyd Company, and the turbine vessel *Admiral von Tirpitz*, 21,600 tons, launched at Stettin. The total output includes four vessels of 26.000 tons fitted with internal combustion engines, the largest being the oil carrier *Wilhelm A. Riedemann*, 9,800 tons.

United States—The tonnage reported from the United States is nearly 8,000 tons less than that of the previous year. This is the only country that shows a decrease, which is entirely accounted for by the fact that, notwithstanding a larger output on the coast, the tonnage launched on the Great Lakes is nearly 42,000 tons less than that which was turned out in 1912.

France—The present returns show an increase of over 65,000 tons as compared with the tonnage launched during 1912. They are the highest for the last 11 years. The figures include two steamers, the *Gallia*, 14,966 tons, and *Lutetia*, 14,582 tons, launched, respectively, at La Seyne and St. Nazaire, and both to be fitted with turbines and reciprocating engines.

Holland—The total tonnage launched in Holland during the past year is the highest ever recorded in the society's returns for that country. This total does not include vessels known to be exclusively intended for river navigation. From information to hand it appears that the tonnage of steamboats, barges and other river vessels launched during 1913 amounts to more than 126,000 tons; so that the total output, including such craft, would appear to reach over 230,000 tons.

Japan—The tonnage launched during the year has only been exceeded once, in 1907, and then only by 1,590 tons. It comprises the steamers *Kashima Maru*, 10,589 tons; the *Katori Maru*, 10,513 tons, fitted with turbines and reciprocating engines, and one of 9,534 tons.

Austria-Hungary—The present figures, 61,757 tons, are the most favorable ever returned for this country, beating the previous record year (1912) by no less than 23,000 tons. They are composed almost entirely of vessels of between 5,000 and 8,000 tons.

Norway—The returns for the year show the output to be 50,637 tons, which is about the same as that for the previous year. As in other years, the total is practically composed of small vessels.

Italy—The output for the year amounts to 50,356 tons, which is double that of last year, and the highest since 1905. There are five vessels of from 5,500 to 6,500 tons included in the returns.

British Colonies—The output of the British Colonies (48,339 tons) is the highest on record. It includes two large steamers, both built on the North American Lakes, one of 6,900 tons, and the other, the *James Carruthers*, 7,862 tons, which was lost during the violent storm which struck the Great Lakes in November.

Denmark—In this country also the record output has been reached. The figures, 40,932 tons, are nearly 15,000 tons higher than last year. Included in this total are four vessels of between 4,600 and 5,300 tons, two of which are to be fitted with Diesel engines. Two other smaller vessels were also launched to be similarly fitted.

TABLE I.—SUMMARY OF THE WORLD'S SHIPBUILDING OUTPUT FOR THE YEARS 1911, 1912 AND 1913

WHERE BUILT.	DESCRIPTION.	1911. No.	1911. Tonnage.	1912. No.	1912. Tonnage.	1913. No.	1913. Tonnage.
United Kingdom	Merchant Vessels	772	1,803,844	712	1,738,514	688	1,932,153
	Warships	50	230,786	30	191,737	49	271,376
	Total	822	2,034,630	742	1,930,251	737	2,203,529
Other Countries	Merchant Vessels	827	846,296	1,007	1,163,255	1,062	1,400,729
	Warships	119	538,083	144	342,892	131	405,533
	Total	946	1,384,379	1,151	1,506,147	1,193	1,806,262
World's Output		1,768	3,419,009	1,893	3,436,398	1,930	4,009,791

TABLE II.—TABLE SHOWING THE TONNAGE OF VESSELS OF 100 GROSS AND UPWARDS (EXCLUDING WARSHIPS) LAUNCHED IN THE VARIOUS COUNTRIES OF THE WORLD DURING THE LAST DECADE

YEAR.	UNITED KINGDOM.	BRITISH COLONIES	HUNGARY	DENMARK	FRANCE.	GERMANY.	HOLLAND.	ITALY.	JAPAN.	NORWAY.	UNITED STATES.	OTHER C'NTRIES.	TOTALS.
1904	1,205,162	30,965	16,645	15,859	81,245	202,197	55,636	30,016	32,969	50,469	238,518	28,254	1,987,935
1905	1,623,168	10,798	16,402	17,557	73,124	255,423	44,135	61,629	31,725	52,580	302,827	25,554	2,514,922
1906	1,828,343	26,042	18,590	24,712	35,214	318,230	66,809	30,560	42,489	60,774	441,087	26,913	2,919,763
1907	1,607,890	46,443	8,717	28,819	61,635	275,003	68,023	44,666	66,254	57,556	474,675	37,807	2,778,088
1908	929,669	34,181	23,502	19,172	83,429	207,777	58,604	26,864	59,725	52,839	304,543	32,981	1,833,286
1909	991,066	7,461	25,006	7,508	42,197	128,696	59,106	31,217	52,319	28,601	209,604	19,276	1,602,057
1910	1,143,169	26,343	14,304	12,154	80,751	159,303	70,945	23,019	30,215	36,931	331,318	29,401	1,957,853
1911	1,803,844	19,662	37,836	18,689	125,472	255,532	93,050	17,401	44,359	35,435	171,569	27,291	2,650,140
1912	1,738,514	34,790	38,821	26,103	110,734	375,317	99,439	25,196	57,755	50,255	284,223	60,622	2,901,769
1913	1,932,153	48,339	61,757	40,932	176,095	465,226	104,296	50,356	64,664	50,637	276,448	61,979	3,332,882

TABLE III.—TABLE SHOWING THE NUMBER AND DISPLACEMENT OF WARSHIPS OF 100 TONS AND UPWARDS LAUNCHED FOR THE VARIOUS NAVIES DURING THE LAST DECADE

Year	BRITISH. No.	BRITISH. Tons.	UNITED STATES. No.	UNITED STATES. Tons.	AUSTRO-HUNGARIAN. No.	AUSTRO-HUNGARIAN. Tons.	FRENCH. No.	FRENCH. Tons.	GERMAN. No.	GERMAN. Tons.	ITALIAN. No.	ITALIAN. Tons.	JAPANESE. No.	JAPANESE. Tons.	RUSSIAN. No.	RUSSIAN. Tons.	OTHER NAVIES. No.	OTHER NAVIES. Tons.	TOTAL. No.	TOTAL. Tons.
1904	33	126,375	14	170,185	3	11,480	9	43,600	11	44,970	4	25,932	4	608	5	1,750	19	10,106	102	435,006
1905	23	96,505	7	98,200	3	11,020	7	28,611	6	36,487	10	14,490	17	50,633	37	15,721	8	11,544	118	363,211
1906	23	85,700	5	45,443	10	2,760	6	15,183	17	62,678	14	3,039	24	41,277	19	82,204	30	24,688	148	362,972
1907	33	133,405	5	11,590	7	1,594	17	33,594	17	14,800	12	25,154	10	57,200	17	35,317	24	8,557	142	321,211
1908	26	49,560	8	52,850	8	16,153	22	21,600	16	97,660	5	29,400	4	2,245	11	8,800	27	31,421	127	309,689
1909	35	98,790	15	48,639	23	22,217	19	95,740	27	99,116	8	2,088	1	375	2	1,246	21	36,264	151	404,475
1910	43	133,525	13	30,287	8	14,993	12	24,063	21	49,024	4	19,374	3	23,100	..	....	18	16,488	122	310,854
1911	41	221,430	13	57,526	2	20,269	15	53,995	28	128,340	15	75,018	6	37,071	5	93,260	44	81,960	169	768,869
1912	28	163,087	15	62,673	7	49,361	21	55,965	30	99,810	35	14,939	4	56,035	1	492	33	32,267	174	534,629
1913	42	187,566	15	10,752	11	9,922	12	75,401	25	148,100	22	52,628	3	55,490	7	27,564	43	109,486	180	676,909

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WORK IN HAND AT THE END OF 1913

At the end of December there were under construction in the United Kingdom, including a number of vessels already launched, but not completed, 73 vessels of between 6,000 and 10,000 tons; 23 of between 10,000 and 15,000 tons; 9 of between 15,000 and 20,000 tons; 2 of between 20,000 and 40,000 tons and 2 of over 45,000 tons each. The total tonnage under construction was 1,956,606 tons.

Outside of the United Kingdom, at the end of December there was under construction throughout the world a total of 1,374,537 gross tons. Germany occupies the first place with 544,682 tons, and next come France with 229,020 tons, the United States with 147,597 tons, and Holland with 126,867 tons. Of vessels the construction of which has been actually commenced, but which were not yet launched, there were 62 steamers of between 5,000 and 10,000 tons, 20 of which are building in Germany; 15 steamers of between 10,000 and 15,000 tons; 3 steamers between 15,000 and 20,000 tons, and 4 steamers of over 20,000 tons (3 in Germany and 1 in France), the largest being of about 56,000 tons, building in Germany, and one of 30,000 tons building in France. These figures include 4 vessels aggregating 104,000 tons, to be fitted with turbines; 5 of 86,500 tons, with a combination of turbines and reciprocating engines, and 4 of 21,200 tons, to be fitted with internal combustion engines. There are also 6 other vessels building on the Continent of between 1,000 and 4,000 tons each to be fitted with this latter type of engine.

New York Motor Boat Show

At the tenth annual National Motor Boat Show, held in Madison Square Garden, New York City, from Jan. 31 to Feb. 7, the high standard of excellence established at previous exhibitions was not only fully sustained but in many respects surpassed. The Garden itself, decorated from floor to ceiling in Venetian effect, presented a scene which was both pleasing and entirely in keeping with the character of the exhibition. On the main floor were the exhibits of boats and engines, while in the gallery could be found practically every type of accessory necessary to complete the equipment of the most elaborate motor craft. Ranging from high-speed boats and cruisers to runabouts and flying boats, the exhibits included splendid examples of the latest developments in practically every type of motor boat. Unique among the familiar pleasure boats were two exhibits of motor lifeboats, both of which were distinct innovations. The first, which was shown by the Welin Marine Equipment Company, Long Island City, was the Lundin decked motor lifeboat built along the lines described in our June, 1913, issue. The hull is 30 feet long by 10 feet beam, built of steel on the double-hull system, with special self-bailing arrangements, and is practically non-capsizable. Power is furnished by a 20-24 horsepower Standard motor, with the propeller running in a tunnel fully protected from damage. The outfit includes wireless apparatus, a life-saving gun, and reels of rope at both bow and stern for establishing communication with other craft for towing or rescue work. The other motor lifeboat exhibited was designed by Capt. McLellan and built by the Holmes Motor Company. Its design follows the lines of the regulation Government 36-foot lifeboat. The beam is 8 feet 6 inches and the draft 2 feet 8 inches. It is double ended, with turtleback decks forward and aft, and a large roomy trunk cabin and self-bailing cockpit amidships. The engine, a 20-25 horsepower Holmes long-stroke motor, is located in the after cabin. Among the engines exhibited, which ranged from the smallest to the largest gasolene (petrol) motors, special interest was attracted to five motors of the Diesel type. One of these exhibited by the New London Ship & Engine Company, Groton, Conn., was a 6-cylinder, 4-cycle, 180-horsepower Diesel motor, with cylinders 9 inches bore and 12½ inches stroke, developing its power at 350 revolutions per minute. The engine weighs 15,000 pounds, exclusive of the reverse gear. Another Diesel engine, which is a new-comer on the market, was exhibited by the James Craig Engine & Machine Works, Jersey City, N. J. This is a self-starting and reversing 6-cylinder, 4-cycle, 200-horsepower engine, with a bore of 9½ inches and 11 inches stroke. A distinctive feature of this engine is the provision of an auxiliary exhaust valve cut in the cylinder walls at the bottom of the piston stroke. A single high-pressure fuel pump feeds all the cylinders through a special distributor. The Fulton Manufacturing Company, Erie, Pa., exhibited a 3-cylinder Diesel engine of 8 inches bore and 9 inches stroke, weighing complete 5,000 pounds and rated to develop 50 horsepower at 400 revolutions per minute. Another new-comer in the Diesel engine field is the Gas Engine & Power Company and Chas. L. Seabury & Company, Cons., Morris Heights, New York City, who exhibited a 175-horsepower, 4-cylinder, 2-cycle Diesel crude-oil motor. The cylinders are 9 inches bore and 12 inches stroke. The engine weighs 16,500 pounds, is self-starting and reversible and develops its power at 350 revolutions per minute. Besides the Diesel engines, a sigle-cylinder, 2-cycle motor of the semi-Diesel type was exhibited by W. R. Haynie, New York City. This motor was a 15-horsepower Bolinder's crude-oil engine of the heavy duty type, fitted with a powerful reverse gear.

In addition to the heavy oil engines, a complete marine producer gas outfit was exhibited by the Wolverine Motor Works, Bridgeport, Conn. The producer was of the Galusha type, adapted to burn coal, coke or charcoal, and was connected to a 3-cylinder, 36-horsepower Wolverine motor, especially arranged for using producer gas.

Progress of U. S. Naval Vessels

The Bureau of Construction and Repair, Navy Department, reports the following percentage of completion of vessels for the United States navy:

BATTLESHIPS

	Tons.	Knots.		Nov. 1.	Feb.1.
New York.....	28,000	21	Navy Yard, New York.....	92.0	96.4
Texas	28,000	21	Newport News Shipb'g....	96.0	98.3
Nevada	28,000	20½	Fore River Shipb'g Co.....	49.2	55.2
Oklahoma	28,000	20½	New York Shipb'g Co.....	48.7	60.8
Pennsylvania ..	31,400	21	Newport News Shipb'g.....	11.8	17.0
No. 39.....	31,400	21	Navy Yard, New York.....	00.0	4.7

TORPEDO BOAT DESTROYERS

Downes	1,010	29	New York Shipb'g.....	81.7	93.7
Aylwin	1,010	29	Wm. Cramp & Sons.....	97.4	100.0
Parker	1,010	29	Wm. Cramp & Sons.....	95.2	100.0
Benham	1,010	29	Wm. Cramp & Sons.....	93.0	100.0
Balch	1,010	29	Wm. Cramp & Sons.....	92.6	92.6
O'Brien	1,050	29	Wm. Cramp & Sons.....	14.9	42.1
Nicholson	1,050	29	Wm. Cramp & Sons.....	13.6	42.1
Winslow	1,050	29	Wm. Cramp & Sons.....	14.2	40.3
McDougal	1,050	29	Bath Iron Works.....	34.3	66.6
Cushing	1,050	29	Fore River Shipb'g.....	21.3	32.0
Ericsson	1,050	29	New York Shipb'g.....	15.1	40.9
No. 57.....	1,090	29½	Fore River Shipb'g Co.....	00.0	6.8
No. 58.....	1,090	29½	Wm. Cramp & Sons.....	00.0	2.6
No. 59.....	1,090	29½	Wm. Cramp & Sons.....	00.0	2.5
No. 60.....	1,090	29½	Bath Iron Works.....	00.0	7.2
No. 61.....	1,090	29½	New York Shipb'g Co.....	00.0	8.9
No. 62.....	1,090	29½	New York Shipb'g Co.....	00.0	8.9

SUBMARINE TORPEDO BOATS

G-4	....	....	Wm. Cramp & Sons.....	96.4	96.4
G-2	....	....	Newport News Shipb'g Co..	89.7	89.7
H-1	....	....	Union Iron Works.....	97.9	100.0
H-2	....	....	Union Iron Works.....	97.9	100.0
H-3	....	....	Seattle Con. & D. D. Co....	98.0	100.0
G-3	....	....	Lake T. B. Co.....	74.2	80.3
K-1	....	....	Fore River Shipb'g Co.....	94.0	99.2
K-2	....	....	Fore River Shipb'g Co.....	91.8	100.0
K-3	....	....	Union Iron Works.....	88.6	91.7
K-4	....	....	Seattle Con. & D. D. Co....	88.0	89.4
K-5	....	....	Fore River Shipb'g Co.....	79.3	88.9
K-6	....	....	Fore River Shipb'g Co.....	78.3	88.7
K-7	....	....	Union Iron Works.....	78.5	83.6
K-8	....	....	Union Iron Works.....	76.4	83.0
L-1	....	....	Fore River Shipb'g Co.....	13.0	22.8
L-2	....	....	Fore River Shipb'g Co.....	13.0	22.5
L-3	....	....	Fore River Shipb'g Co.....	13.0	22.5
L-4	....	....	Fore River Shipb'g Co.....	13.0	22.4
L-5	....	....	Lake T. B. Co.....	7.4	7.4
M-1	....	....	Fore River Shipb'g Co.....	9.7	14.1

COLLIERS

Kanawha	14,000	14	Navy Yard, Mare Island...	9.4	31.5
Maumee	14,000	14	Navy Yard, Mare Island...	5.3	17.5

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Letters from Practical Marine Engineers

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs

Repairs to Broken Eccentric Strap

I was in the steamship ——— when the following breakdown happened. We had crossed the Western Ocean and were within a few hours' sail of our discharging port on the Continent, when the intermediate-pressure ahead eccentric strap broke. It was a cast iron strap, lined with white metal, with distance pieces of cast iron between the top and bottom halves. The valve gear was of the Stephenson link-motion type, with open rods.

The break was right through the center of the stud hole, as shown on Fig. 1. When it occurred the engines were stopped and the broken strap taken off, to be replaced by the astern one, a little adjustment with liners bringing the gear right with the trammel marks on the spindle at the guide bracket. The astern rod was disconnected, and the weight of

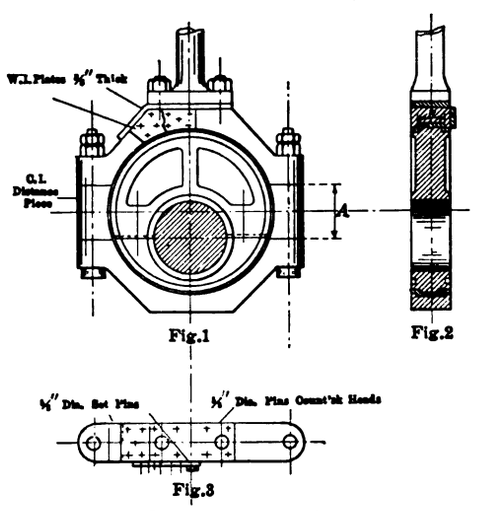


Fig.1 Fig.2 Fig.3

Broken Eccentric Strap

the unsupported end of the link was taken up with rope tackle. When the engines were started the tackle was found unnecessary, and so was dispensed with. After a delay of about five hours we were able to proceed to port without any further mishap; of course, being minus the astern rod and strap the engines could not go astern, so the assistance of a tug was required to bring us alongside.

The repairs executed in this port were as follows: The white metal in the broken strap was dressed up, then two wrought iron plates, ⅜ inch thick, were made; one to cover the break on the top and front and the other on the side, as shown in Figs. 1 and 3. These plates were fixed by ⅝-inch diameter screwed pins; those under the butt of the rod having countersunk heads.

As the break was "clean," there was no difficulty in "knitting" the two parts together or in replacing the stud. The two halves were then bolted on the astern eccentric, and the distance *A*, Fig. 1, taken with inside callipers. When this size was compared to the length of the distance pieces it was found necessary to cut ⅜ inch off of them. When this was done, the astern rod was connected up and the valve set. After closing up, the engines were turned both ways satisfactorily. We left for London, and arrived there without having had any trouble on the passage across, the repaired eccentric successfully standing the many maneuvers going up the river.

The cause of the mishap, in my opinion, was due to the eccentric running slack. This was occasioned by the white metal breaking off round the edge, part of which probably found its way into the center of the bearing surface, hence the wearing down of the strap.

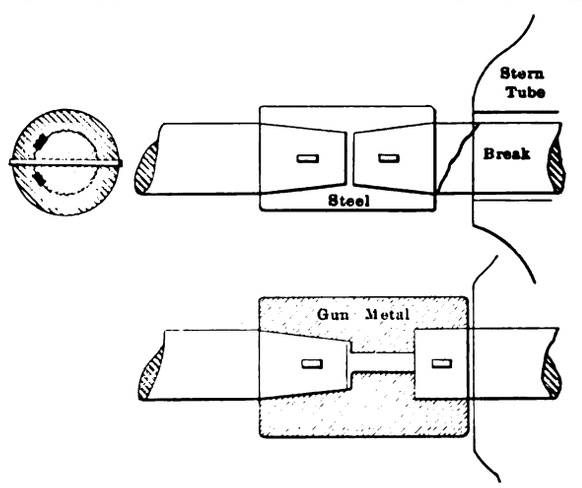
When we were repairing the strap, I observed that the white metal was fixed in, as shown in Fig. 2. The recess *B* in the strap, I think, was too broad, leaving but little surface to support the strip of white metal at the edge. The nuts fixing the butt end of the eccentric rod were found to have slackened back, which may account for the break happening where it did.

M. C.

Glasgow.

Broken Propeller Shaft

The starboard propeller shaft of a United States gunboat cruising along the South American coast carried away abaft the stern tube. The broken shaft worked out before the ship was stopped, until the sleeve coupling on the shaft brought up on the strut and prevented the loss of the propeller. A line with a noose-end was put over the stern and slipped over the propeller blade and made fast on deck, when the vessel went ahead, steaming five days with the port engine alone to the next port. Upon arrival the vessel was docked, and examination disclosed that the fracture occurred at the forward



Gun Metal Sleeve Cast to Replace Steel Sleeve on Broken Shaft

end of a sleeve coupling used to join two sections of the shaft and close to the end of the stern tube.

Repairs were made without removing the shaft from the ship. The steel sleeve coupling was removed. The shaft was uncoupled in the engine room and shoved outboard about 9 inches, a distance piece 9 inches thick being then fitted between the flanges and longer bolts substituted. A gunmetal sleeve was cast, much larger in diameter than the cast steel sleeve which it replaced, and bored to fit the taper on the after section of the shaft and bored straight and pressed on the forward section, using as before two feathers and one key in each end to secure it to the shaft. The break was so close to the end of the stern that it was necessary to move the shaft outboard 9 inches to obtain bearing surface for the new coupling, the remaining distance between the ends of the shaft being made up by the coupling. The shaft was of nickel-steel, tough and hard to work, and to dress off the jagged end,

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cut the keyways and fit the keys and coupling with the shaft in place in the ship with hand tools required skill and patience.

J. E. CLEARY.

Philadelphia, Pa.

How an Engineer Saved His Ship

Marine engineers perform deeds of heroism in the ordinary routine of their duties which, if they were known, would win the plaudits of an admiring public. Unlike the railroad engineer, whose many deeds of heroism are all necessarily performed in the limelight, the marine engineer works below decks, out of sight, and at sea, where comparatively few persons come in contact with him, so that, while both classes of engineers do their duty without any hope or expectation of fee or reward, the marine engineer seldom gets credit for the many deeds of valor he performs.

During a heavy gale the tail shaft of a transatlantic steamship broke obliquely in the stern tube, so that one section of the break rode on top of the other section as the propeller revolved in the seaway, breaking the stern tube and tearing the flange on the end from the watertight bulkhead in the after end of the shaft tunnel. The water poured into the tunnel in torrents through the bulkhead and it immediately became apparent that a serious condition of affairs existed.

The watertight door in the engine room bulkhead at the forward end of the tunnel, of course, could have been closed, but the chief engineer was sure that this would not do, as he had grave doubts as to the ability of the tunnel casing to withstand the pressure of the water when it filled. He knew that if the tunnel casing gave way the ship was doomed, for the reason that when the after hold filled the engine room bulkhead would go. In the days when this ship was built watertight bulkheads were a delusion and a snare.

He was reasonably sure that the after bulkhead would hold, as it was of small area and more substantially built and securely fastened to the frames of the ship than the larger engine-room bulkhead, so he decided that the proper thing to do was to get the stern tube back in place, thus stopping the leak.

Most engineers can imagine what a task this was, working in such cramped quarters, water pouring in around the tube, which was in constant motion with the working of the shaft, with only such appliances as were to be found aboard a ship to work with, and time so limited that minutes were precious. Little time was wasted in discussing the question as to what was the best thing to do. Not a man in the engine-room force faltered or questioned the advisability of the chief engineer's decision.

Several pieces of 6-inch by 6-inch scantling, together with blocking that was kept in the engine-room for various purposes and some screw-jacks from the store room, were hastily secured and, led by the courageous little Scotch chief, the engineers started back through the long shaft tunnel for the scene of operations.

By the time they had reached the after end the water was up to their knees and rising rapidly in spite of the fact that all of the pumps that could be used were working on the after compartment.

It was a heartrending task that confronted these heroic men. The propeller was threshing around in the seaway, causing the end of the tube in the shaft tunnel to jump around pretty lively; the ship was pitching and tossing in the heavy sea and every piece of wooden blocking had to be firmly held on to. One piece that slipped from the hands of one of the men narrowly escaped dashing the brains out of another man as it rushed by his head, floating on top of the water while he stooped under the shaft.

Several attempts were made to get the ends of the pieces of scantling against the flange on the end of the tube, the intention being to block between the other ends of the scantling and the foundation of the after spring bearing and force the tube back in place with the screw-jacks. This sounds simple enough, but almost any mechanic can see what a troublesome task this would be alongside of a dock in smooth water, holding the scantling in place, placing the blocking and setting the screw-jacks, but under the conditions then existing it seemed as if it would be impossible to do it. About the time the blocking would be adjusted the tube would jump and throw the ends of the scantling off, or just as the screw-jacks were to be put in place a hand would be taken off the blocking, which was entirely under water, and it would all float adrift and would again have to be replaced.

However, these men were of the type who never say die—most marine engineers are—and they kept at it. During a momentary lull, such as is customary even in the heaviest sea, the scantling and blocking were held in place long enough to get the screw-jacks in and a strain taken on them, and then the rest was easy. The screw-jacks were rapidly set up, although the men operating them had to go entirely under water to do this, and when the flange had been forced back in place on the bulkhead the water had risen so that the heads of the men were just out of it.

It required only a few minutes for the pumps to clear the shaft tunnel when the opening was closed, and then the tube was more securely shored and braced and the engineers were enabled to change their wet clothing and get a respite from their arduous labors. There was no real rest for them even then. The shores had to be constantly watched and, as they loosened up with the vibrations caused by the threshing around of the broken shaft, they had to be tightened up and sometimes replaced, although, fortunately, as all of them would not get out of place at the same time, the tube was not again forced out of its position.

Another ship belonging to the same company happened to come near enough to see the signals of distress (this was before the days of wireless telegraphy, with its S. O. S. call for assistance so promptly answered by other ships which otherwise would know nothing of the trouble), and after as pretty a piece of maneuvering as had ever been seen at sea, passed a line and towed the disabled ship into port.

The writer had the opportunity of examining this, to him, splendid feat of marine engineering on the arrival of the ship in Antwerp, where she was taken for repairs, and the one thing that impressed him most, aside from the difficulty of the task as performed, was the extreme modesty and indifference to praise displayed by the chief engineer, who was the brains of the whole operation, as well as the leader in the actual doing of the work. He acted as if it was all in the day's duties and called for no special commendation or notice, although there is hardly a doubt that if he had decided to do what many men would have done under the same circumstances—close the watertight door in the engine-room bulkhead—the ship would have been lost, because investigation showed that neither the tunnel casing nor the engine-room bulkhead would have withstood the pressure had the tunnel been allowed to fill.

Marine engineers have not in the past received, nor do they get now, the credit that is due them for the many deeds of valor they perform, although in later years they are receiving more recognition than they did 25 years ago. However, like all courageous men, they are not brave because of the recognition it brings. They are brave simply because they are brave.

COMMANDER OF THE NEWPORT.—Capt. James R. Driggs, who was selected by the board of governors as commander of the New York State Nautical Schoolship *Newport*, assumed command on Feb. 1. Capt. Driggs is a graduate of the schoolship *St. Marys*, class of 1882, and has spent his life in continuous service as an officer in the merchant marine.

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Marine Articles in the Engineering Press

German Shipbuilding, 1913.—The statistics of the Germanic Lloyd show an increase of number and tonnage of ships building in 1913 over those in 1912, with a total of 1,384 merchant ships of 1,368,187 gross tons, of which 250 ships aggregating 1,167,442 gross tons are each over 100 tons; in addition there were building 54 warships of 161,780 gross tons. The increase in merchant ships is almost exclusively in ships over 100 gross tons, while the warship tonnage has actually decreased 15,000 tons below that of 1912. Objection is raised against gross tonnage as an accurate measure of the size of ships, as so much can be done arbitrarily toward a reduction of tonnage by special hatchways in deckhouses or upper decks, perhaps not found on other ships of equal carrying capacity. Also, so far as regards completed ships, 1913 showed the largest output, with a total of 914 merchant ships of 467,873 gross tons and 22 warships with 55,860 gross tons. The large tonnage of motor ships completed is characteristic for German shipbuilding, and also for Danish and Dutch shipbuilding, but it is almost wholly lacking in English shipbuilding. Considering the figures of gross tonnage still building at the end of the year 1913, the amount is greater than last year, with a total of 470 merchant ships of 900,314 gross tons and 32 warships of 105,920 gross tons. The additional tonnage is due to steam seagoing vessels, while seagoing motor ships and river boats show a reduction in tonnage. 3 tables. 1,000 words.—*Schiffbau,* January.

The Outfit of Wireless Telegraphy on the Imperator.—The article describes the unusually large outfit, which consists of two distinct plants, one long distance of 7.5-kilowatt antennæ energy, one of 1.5 kilowatts, and one for emergency. The antennæ of the large plant are four in number, 557 feet 9 inches long, while the small ones each have one wire from the mast to one of the stacks and to the station. Rotary transformers supply current for the two regular plants, while a storage battery can supply the emergency outfit for six hours. Wide variation of frequency of alternating current and of wave lengths is possible to adjust the telefunken system to give its musical sound with the required strength and clearness. The apparatus for the large and small plants is described in detail. The range proved far in excess of the guarantee of 990 miles for day and 1,980 miles for night service, as the ship usually is in connection with either Europe or America. The three operators are berthed in the station. 11 illustrations. 2,000 words.—*Schiffbau,* November 26.

U. S. S. Cummings, Trial Performance.—By Henderson B. Gregory. The trials of the *Cummings* were conducted Aug. 26 to 28 on the Rockland measured mile course. Twenty-six runs were made at various speeds, the data from which are tabulated and curves plotted for R. P. M. on knots and R. P. M. on shaft horsepower. On her four-hour full power trial the vessel made a speed of 30.574 knots with the engines developing a collective shaft horsepower of 16,335. 1 illustration. 800 words.—*Journal of the American Society of Naval Engineers,* November.

The Heating of Frame and Plate Furnaces.—By John Hamilton Paterson, D. Sc. This article has been written with a view to showing how the selection of suitable fuel may be accomplished and the proper burning of it adequately attended to. The unit chosen for comparison of different fuels is the gross number of heat units obtainable for one penny after all the costs of handling the fuel have been added to the price per ton. This unit is referred to as the "Absolute Heating Value (A. H. V.)." From the data presented the following values of this unit are found for certain fuels: Washed slack coal, 187,500; screened steam coal, 161,000; producer gas, 160,000; oil fuel, 41,000; town gas, 31,000. If these fuels can be burned in an ideal furnace, in which all the heat is utilized in heating frames or plates, it is evident that the poorer coals would be easily the most economical, good coal and producer gas being about equally efficient and oil fuel and town gas entirely out of the question. As it is not economical, however, to use high ash coal for firing frame furnaces, the proper construction of furnaces is considered in order to show which type of furnace is best suited for the various fuels and which has proved most economical. It is pointed out that with the most suitable furnace and with proper care in the selection of the coal used, the greatest economy possible can be effected by using producer gas, although many failures have been credited to this method of firing frame furnaces. The author points out the features which should tend to make such an arrangement a success. 4 illustrations. 2,850 words.—*The Shipbuilder,* January.

U. S. Fleet Colliers Proteus and Nereus.—By Henderson B. Gregory. These vessels, designed for a speed of 14 knots when carrying not less than 12,500 tons of cargo and bunker coal corresponding to a displacement of about 19,000 tons, with the main engines developing about 6,700 indicated horsepower, were built by the Newport News Shipbuilding and Dry Dock Company, Newport News, Va. Their main dimensions are: Length over all, 521 feet 9 inches; length between perpendiculars, 500 feet; beam, extreme, 62 feet 2½ inches; beam, molded, 62 feet; mean designed draft, 27 feet 6 inches; displacement at designed draft, 19,080 tons. A detailed description is given of the hull, the deck machinery, cargo gear, heating, ventilating, drainage, pumping and sanitary systems, and also of the main and auxiliary machinery. Propulsion is by two 3-cylinder triple-expansion engines, with cylinders 26, 43½ and 74 inches diameter, with a common stroke of 48 inches driving three-bladed propellers, 16 feet 6 inches diameter, 16 feet 5 inches pitch, as set, with a projected area of 79.11 square feet, a helicoidal area of 90.6 square feet and a disk area of 213.81 square feet. Steam is furnished at 200 pounds pressure by three Scotch boilers, 15 feet 9 inches mean diameter and 21 feet 5½ inches length of shell. Standardization trials were run over the Delaware Breakwater course, from which it was found that it required an average of 96.2 and 94.55 revolutions per minute of both main engines for the *Proteus* and *Nereus,* respectively, to give the contract speed of 14 knots. On the eighteen-hour full power trials the *Proteus* attained a mean speed of 14.675 knots with her engines developing 7,207 indicated horsepower. On this trial the *Nereus* attained a speed of 14.575 knots when developing 6,904 indicated horsepower. In addition to the standardization and power trials, tests were made of the coaling gear, and appliances. On the *Proteus* coal was delivered at the rate of 134.5 tons per hatch per hour, which is nearly twice the guarantee of 75 tons. On the *Nereus* the average rate of discharge per hatch per hour was even better, being 144.4 tons. 3 illustrations. 8,200 words.—*Journal of the American Society of Naval Engineers,* November.

German Paddle-Wheel Tugboat for the Rhine.—The firm of Sachsenberg Bros., in Rosslau, on the Elbe, completed in 1913 a paddle-wheel tugboat for the Rhine, the *Doertelmann Bros. II,* 240 feet long, 27 feet 11 inches beam, 10 feet 10 inches deep at side and 3 feet 11 inches draft. The boat has ten cross bulkheads, of which eight are watertight. The main deck is of corrugated iron. The crew is berthed forward and the officers aft, with the galley, toilets and storerooms on the

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wheel sponsons. The bridge is between the stacks well up above the main deck. The auxiliary machinery equipment is very complete, containing steam and hand-steering gear, windlass, six towing winches on the forward deck, each with sufficient capacity to take an entire towing hawser. The hawsers are guided along and well above the deck and clamped to a built-up and braced wrought steel skeleton towing bit, six side towing bitts are arranged aft of the wheel casings and the short sponsons to hook up to barges aft alongside. The anchors hang under the bowsprit outboard; two boats are swung on davits on the forward deck. The mast and the two smokestacks can be folded down. The boat has two Scotch boilers, 13 feet 1½ inches diameter by 11 feet long, for 205 pounds working pressure, and a triple-expansion diagonal paddle-wheel engine with three cranks, normally developing 1,300 indicated horsepower. The paddle-wheels have each seven feathering curved steel buckets 15 feet 6 inches wide. 4 illustrations. 650 words.—*Schiffbau*, November 26.

New German Motor Boats of the District Teltow.—The large passenger traffic on lakes and rivers and canals of the district of the rivers Havel and Spree, near Berlin, requires special boats with continuous upper deck of large area and considerable shelter space below. The district authorities instituted in 1910 a prize competition for the best design suitable for the conditions, to have large passenger capacity, good speed and little wave disturbance, that might prove least destructive to canal banks. Twenty-three designs were offered. To test their efficiency, towing experiments were made in the experimental tank of the government in an exact copy of the profile of the Teltow Canal. The waves automatically recorded their heights by floats actuating recording pencils. The results showed that the principal factor of the wave-making in restricted canal profiles was the 'midship section, leading thus to a scow shape of boat with very full waterlines and the minimum of 'midship section. On strength of these investigations a new design was developed, and boats built by Saschenberg Bros. Company, in Rosslau, and named *Tempelhof* and *New Koelln*. Practically two full decks are provided with a small cabin near the engine room for seating accommodations for the passengers. The machinery plant consists of two oil engines of 50 horsepower each, built by H. Kamper, in Mariendorf, driving twin screws and reversing by clutches, which are operated by the pilot. The speed in open water is 10 to 10½ miles per hour. A comparison between the tests of a normal shipshape body and the new boats shows a remarkable reduction of wave heights to nearly one-half. The new boats are 98 feet 5 inches long over all, 17 feet 9 inches beam and 15 inches light draft. 31 illustrations. 1,850 words.—*Zeitschrift Verein Deutscher Ingenieure*, November 8.

German Railway Ferryboats for Hamburg.—The port of Hamburg had built recently two railway ferries for service across the southern channel of the Elbe, of the twin-screw double-ended type and similar to Glasgow ferries, with a movable deck to allow for changes in tide. The ships were built by the Vulcan Works, in Stettin, while the bridge-like construction of the movable deck and its support was sublet to the machine works, Augsburg-Nurnberg. The ships are 116 feet 6 inches long on the waterline, by 50 feet 10 inches molded beam by 12 feet 6 inches deep, with a light draft of 8 feet 2 inches and a load draft of 9 feet 3 inches with six 30-ton cars. Their weight, light, with 15 tons coal, is given as 930 tons and their speed as 8 knots. They are built of steel, strengthened for ice, and fitted with six transverse and two longitudinal bulkheads. A description is given of the girder structure, the movable deck and its lifting gear, deck fittings and mooring arrangements. The pilot house of teak contains control gear directly to the reversing lever of main engines, which steer the ship, the rudders being only supplementary. The triple-expansion engines are heavy, symmetrically arranged for ahead and backing motion and with a late cut-off for quick starting. The diameters are 12¼ inches and 18⅝ inches and 29⅛ inches by 19⅝ inches common stroke, and each engine develops 320 indicated horsepower at 150 revolutions per minute. The auxiliaries comprise 2 Brown reversing engines, 1 independent Edwards air pump, 1 circulating pump, 1 condenser of 861 square feet cooling surface, 1 dynamo, 1 steering engine, 1 windlass engine, 2 duplex feed pumps, 2 duplex bilge pumps, 1 deck lifting engine and 2 injectors. The shafting of each engine has 2 thrust blocks and 2 propellers. The feed water passes through an oil filter and a heater. There are 2 two-furnace Scotch boilers, each with 864 square feet heating surface and 28.4 square feet grate area, built for a working pressure of 176 pounds per square inch. 16 illustrations. 3 plates. 7,020 words.—*Schiffbau*, October 8-22.

Two-Cycle Diesel Marine Oil Engines, Developed by Werf Gusto.—This article gives a detailed description of a 200 brake-horsepower, three-cylinder, two-cycle Diesel engine built by Werf Gusto, Schiedam, near Rotterdam, for a Dutch passenger vessel. The engine is of the stepped-piston type, an extension of the main cylinder carrying the stepped extension of the main piston. With this design the scavenging pump is very shallow, while the bearing pressure between it and the cylinder wall is comparatively low and not subject to any great heat. Scavenging of the cylinders is accomplished by means of single ports, thus requiring no valves in the cylinder head, as the entry of the scavenging air into the cylinder is controlled by the travel of the main piston. The only valves in the cylinder head are the fuel injection valve and the starting air valve, driven in the usual way by cams and levers. Compressed air for fuel injection and for starting is supplied by a two-stage compressor driven off the end of the crank shaft. For powers above 300 brake-horsepower, Messrs. Werf Gusto adopt a cross-head type of two-cycle engine, which is remarkable in that the scavenging pump is combined with the engine cross-head, guide shoes and guides, the main cylinder being separated from the scavenging pump by a distance piece, which is also made to act as a reservoir for the scavenging air. 10 illustrations. 1,800 words.—*Engineering*, December 19.

The Channel Steamer Paris and Geared Turbines.—The Channel steamer *Paris* was built for the London-Brighton & South Coast Railway Company by Messrs. Denny of Dumbarton. The vessel is engined with Parsons turbines, driving the propellers through spur gearing. The power transmitted through the two gear wheels is about 14,000 shaft-horsepower, which is the most powerful installation of this type of machinery up to date. An indication of the progress made in the development of this type of machinery is gained from the fact that, while in 1910 the total power of geared turbines completed or under construction was 15,000 horsepower, in 1911 it was 32,500 horsepower, in 1912 it advanced to 118,050 horsepower, while to-day it is 435,450 horsepower. The *Paris* is 300 feet 6 inches long on the load-waterline, 35 feet 6 inches molded breadth, 23 feet 3 inches molded depth, with a gross tonnage of 1,774 tons. The mean draft on service is 9 feet ½ inch and the displacement 1,510 tons. The propelling machinery is arranged on two shafts, each driving a three-bladed solid propeller of Stone's "Turbiston" metal. On the trials between New Haven and Dieppe the propellers ran at 435 revolutions, giving a speed of 25.07 knots. The high-pressure and low-pressure turbines made 2,610 and 1,849 revolutions, the pinnions being then in the relation of 6 and 4.25 to 1 of the gear wheel on the shaft. Each shaft has a high-pressure turbine and a low-pressure turbine, and an astern turbine is incorporated in each of the latter. 23 illustrations. 5,000 words.—*Engineering*, December 5.

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New Books for the Marine Engineer's Library

MARINE TURBINES. By G. Bauer and O. Lasche. Size, 5½ by 8 inches. Pages, 442. Illustrations, 260. Munich, 1913: R. Oldenbourg. Price, $3.75.

The well-known German authority on marine engineering, Dr. G. Bauer, in conjunction with O. Lasche, has produced this volume as a supplement to his previous publications on marine reciprocating machinery. On account of their extensive experience with turbine work at the Vulcan Works, Stettin, and at the A. E. G. Works, Berlin, the authors were able to give a very large amount of valuable information covering the subject of marine turbines. Not only is there a complete theoretical treatment of the subject expressed in clear language with a minimum of higher mathematics, but also a complete discussion of the practical side of the subject, replete with descriptions of details, which will be much appreciated by men engaged in the actual construction of turbines.

The authors devote a few short chapters of introduction to the advantages, application, systems, power measurements, steam consumption and maneuvering qualities of the marine turbine. Following this are several chapters on general design, discussing the value of different diagrams, plotted either for pressure and volume or for temperature and entropy or for heat and entropy, and showing the calculation of the total efficiency of a marine turbine plant. It is also shown how this efficiency and the steam consumption are influenced by the vacuum, superheat or moisture of the steam.

From theoretical steam velocities, the reader's attention is directed to the influence of the forms of admission nozzles of various types upon the so-called critical pressure, and this is well exemplified by complete calculations. The distinction between reaction and impulse turbines is pointed out, as well as the working operation through the blades and their efficiency at different angles.

Blading is discussed in regard to strength, dimensions, division, etc., and also in regard to the effect of shifting the rotor in the axial direction, which requires the provision of relief pistons and dummies, usually so arranged and proportioned that they offset the propeller thrust and enable the thrust block to be quite small. The critical number of revolutions of the turbine shaft is exemplified, showing the great necessity for careful design, construction and balancing to prevent excessive deflections of the shaft under even a small eccentricity of the center of gravity.

General remarks on turbine plants deal with the number of shafts, the number of turbines on one shaft in either one or more casings, and with steam consumption, as well as the initial and final steam pressures, which are usually decided upon before the design is begun. It is pointed out how the choice of the diameters of the wheels or drums depends upon a number of factors, as, for instance, clear head room above the turbine, circumferential velocity and revolutions. Complete calculations are given for the layout of a drum turbine, as well as a mixed system turbine, with details regarding the pressure at the nozzles, the drumhead pressure, the drop of temperature in and the work done by the Curtis stages, the losses in the stuffing-boxes and the number of stages on the drum. Many readers will appreciate the approximate calculations for turbine plant and a statement of the proper or desirable dimensions of turbines.

The practical part of the book is devoted to the structural details of the forms and material of blades, their supports and clearances; also of the rotors and their shafts; of the guide blades; nozzles and subdividing disks; of the casings, mentioning the necessity for their careful design and construction; of the stuffing-boxes and the dummy rings; of the main and thrust bearings; of the steam piping and its details, such as the separator, stop valve, reversing valves, drain, oil and cooling water piping, and of the necessary lifting gear. Due attention is given to the shafting, its material and its bearings; to the propeller, its pitch ratio, its circumferential speed and area pressure, its limit of revolutions and its construction.

The various arrangements of turbines in a ship are described and examples given for a number of installations on torpedo boats, cruisers and battleships as well as merchant ships. Following a chapter on the exhaust steam turbine, the authors describe the Föttinger hydraulic transformer and the gear drive. A chapter is also devoted to each of the following subjects: Marine auxiliaries with steam turbine drive; measuring apparatus; practical instructions upon the operation and the conservation of marine turbines, and miscellaneous tables.

The large number of diagrams, drawings and plates, together with the use of clear print, good paper and excellent binding, add much to the usefulness and value of the book.

RESISTANCE AND PROPULSION OF SHIPS. By Dr. Eng. Rothe. Size, 7 by 10 inches. Pages, 287. Illustrations, 150. Berlin W., 1912: Mr. Krayn. Price, $2.85, bound.

The author states that in addition to the American and English investigations of the Frondes, Taylor, etc., he has considered for his deductions the experiments made by Germans. These latter and later investigations of Ahlborn, Flamm, Wagner, Gebern and Kempf have led the author to conclusions somewhat at variance with previous opinions. In the different forms of resistance he distinguishes force line, eddy, skin friction and cavitation resistances for totally submerged bodies. The stream line theory does not appeal to the author. For partly submerged bodies additional resistance is stated to be supplied by wave, wave surface and air disturbances. The author discusses the determination of resistance for new designs from the point of view of formulas, model experiments and deductions from similar ships. The accuracy of the first two methods appears to the author doubtful, as even the tank towing experiments may sometimes be misleading. The propulsion of ships deals successively with turbine propellers and counter propellers, paddle-wheels and screw propellers. For the latter two types several chapters are devoted to their construction, operation, strength and power effects and efficiency. The calculation of screw propellers is considered from previously-built propellers, for which three examples are given. In addition a number of tables of coefficients and data are given. The book represents a valuable attempt to make use of all the latest investigations and to harmonize them with all that is valuable and fundamental from former experience in this subject.

ZINC AND CADMIUM. By R. G. Max Lisbig. Size, 7 by 9½ inches. Pages, 598. Illustrations, 206. Leipzig, 1913: Otto Spamer. Price, $8.00.

The very size of the work indicates the thorough familiarity of the author with his subject. He takes up successively: the ores and other raw materials of the metals; their physical and chemical qualities and combinations and the laboratory processes of analysis; also an extensive history of the metals and the methods of obtaining them. A long chapter is devoted to modern methods, roasting furnace construction, retort making, mixing machinery and the methods and apparatus for reduction and condensation for making use of by-products and the refining of the metals. After giving a special short chapter to cadmium, the author touches upon the production and application of zinc, zinc white, zinc dust and cadmium, and concludes his work with two chapters on special methods of obtaining zinc. A number of statistical tables on production, price and existing plants are added.

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ENGINEERING SPECIALTIES

Schmidt Marine Superheaters

The Schmidt fire tube superheater, manufactured by the Locomotive Superheater Company, New York, consists of collector castings and a system of units or elements made up of U-bent tubes, the material of which is cold-drawn seamless steel. The collector castings are located in either a vertical or horizontal position in the uptake end of the boiler. The units, which are arranged in groups leading in and out of the uptake end of the flues, are expanded in the flanges or collars, which in turn are fastened to the collector castings. In joining the ends of the unit pipes to the collector castings one end of the pipe is in communication with the header from the boiler and the other with the steam pipe leading to the engines. Thus the steam in passing from the boiler to the engines must pass through the units or elements in the tubes, where the superheating takes place. The connection between the units or elements and the collector castings is made by means of a single clamp using but one bolt or stud, thus facilitating the removal of the units should occasion demand their removal.

The units are formed by welding the straight sections of the pipe to a forged return bend, whose thickness is somewhat greater than the thickness of tube. By this form of construction each unit consists of a single continuous pipe and does away with screwed joints or connections which might be contributory to leaks. The construction of the Schmidt superheater is evident from Figs. 1 and 2, which show its application to an internally fired Scotch marine boiler.

The superheater may be installed in existing power plants at a comparatively low cost, resulting in fuel economy as well as increased power output. The reduction in the flue area for gases by the introduction of the superheater is not a serious matter if sufficient draft is provided and unit pipes of the proper diameter are used. As the coal consumption is greatly reduced by the increased efficiency of the plant, the volume of gases passing through the flues is proportionately reduced. It is claimed that this condition more than makes up for the restriction of gas area resulting from the installation of the superheater. If the draft should prove insufficient, it can be

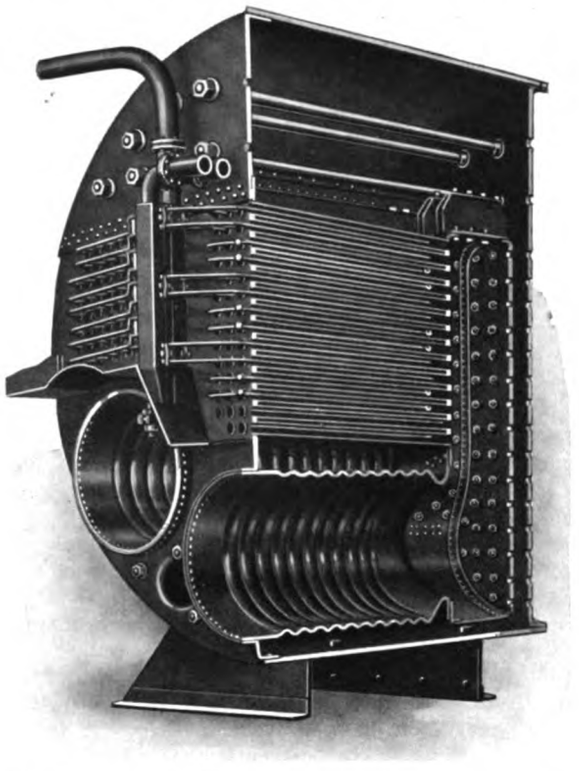

Fig. 2.—Sectional View, Showing Location of Superheater Elements in Fire Tubes

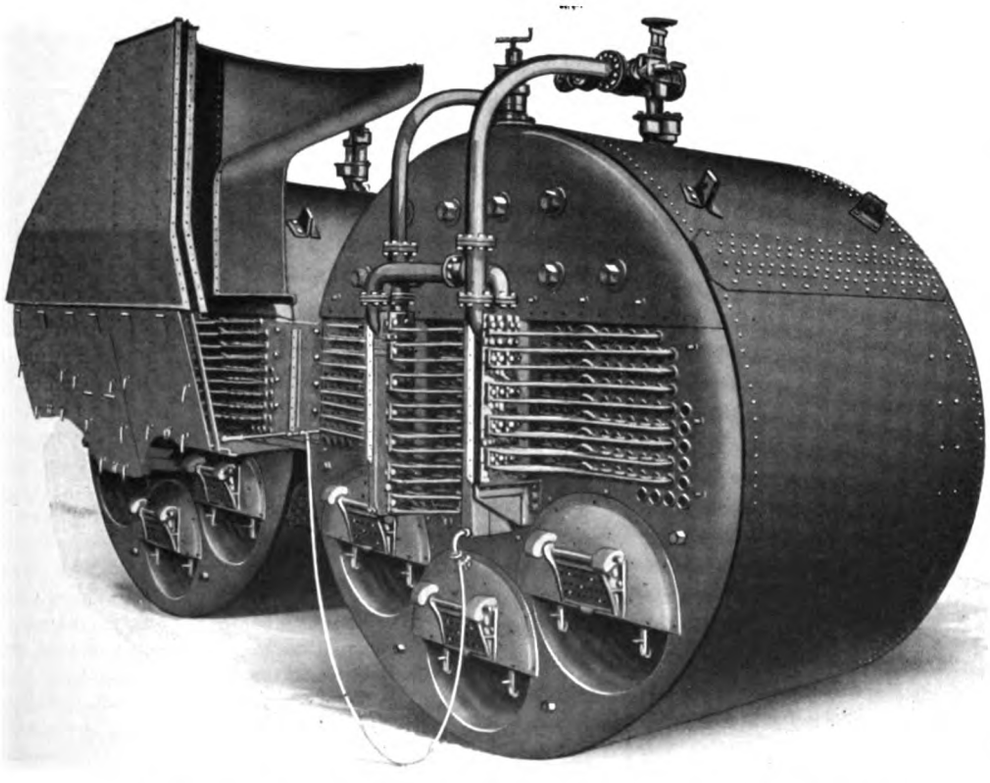

Fig. 1.—Schmidt Fire Tube Superheater Installed in an Internally Fired Marine Boiler

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remedied by providing a forced or induced draft system of larger capacity. The cleaning of the superheater and boiler tubes can be easily effected by steam jets specially provided for the purpose and the introduction of the superheater pipes does not interfere with the well-known "Diamond" blower system used so extensively in cleaning flues while under way.

Where superheated steam is used, the material for pipe lines and fittings should be of steel and cast steel, respectively. Other metals, such as copper and bronze, lose their strength in high temperatures and should be avoided in piping and fittings that are to be used in connection with highly superheated steam. In selecting the engines to be used in connection with superheated steam, the high-pressure cylinders should, if possible, be served by either piston or poppet valves. The use of an inside admission piston valve for the high-pressure cylinder, as in ordinary practice, is the type of valve that will give satisfaction. For equal engine power the cutoff when using superheated steam must be somewhat increased above that for saturated steam. This variation can, as a rule, easily be obtained in the adjustment of the valve gear without any alteration in the position of the eccentrics. It is recommended that in new construction the high-pressure cylinder be made somewhat larger than is made for saturated steam, if it is desired to maintain the same cutoff in the low-pressure cylinder.

At the present time there are over 900 steam vessels, totaling over 1,000,000 horsepower, equipped with Schmidt marine superheaters.

The most economical results are obtained when a steam temperature of 580 to 620 degrees Fahrenheit is employed. The advantages claimed for this type of superheater are as follows:

1. It is adaptable to either new or existing boilers of the firetube type and can be applied with no change in design or construction.
2. It increases the output of power of a given marine power plant from 10 to 25 percent.
3. It will produce the same power output with fewer boilers.
4. It reduces the size of coal bunkers, thereby reducing the draft of the vessel with a given cargo or making possible an increase in revenue cargo.
5. It results in a saving of fuel over similar plants not equipped with superheaters as follows: Compound engines, 18 to 25 percent; triple expansion, 12 to 18 percent; quadruple expansion, 10 to 12 percent.
6. It reduces the maintenance cost by the prevention of water hammer, leaky flanges and condensation in the cylinders.
7. It permits rapid, thorough and frequent cleaning of the smoke and superheater tubes from ashes and soot without opening the smokebox door.
8. Its construction provides easy access to all screwed joints for ready removal of same.

Preventing the Spread of Flames in Pier Sheds

No matter what precautions are taken in the way of fireproof floors, enclosed escapes and doors that open outwardly, the lives of workers have frequently been jeopardized by the rapid spread of flames through inflammable material, even though the blaze has been confined to a single floor. This condition indicates that the real solution to the problem of safeguarding life and property is to provide adequate means for extinguishing the flames before they have a chance to gain headway.

To this end the H. W. Johns-Manville Company, New York, has brought out an extinguisher, known as the J-M Fyro, which discharges, by means of compressed air, a liquid gas said to be 40 times as effective as water. No mechanical force is required to operate it. All that is necessary is to hold it in an upright position and turn a small valve wheel about the size of a silver dollar. It measures only 3 by 15 inches and throws a spray as well as a stream; the spray can be thrown a distance of 10 feet; the stream 25 feet. The spray is most effective on small fires scattered over a comparatively large area; the stream is usually best for small fires concentrated in one spot. The advantage of the spray is that it will cover the entire blaze of the average incipient fire so that all of the liquid gas volatilizes. In so doing the gas forms a dense combustion-arresting "blanket," which is five times as heavy as air, and on account of its density and weight it quickly envelopes the flames, displacing oxygen and extinguishing the fire.

The Lennox Serpentine Shear

The Lennox Serpentine Shear, a new type of machine now being offered by Joseph T. Ryerson & Son, Chicago, is designed particularly for the straight and irregular cutting of sheets and plates. The frame is a steel casting of spiral construction designed to provide sufficient clearance for material of unlimited length or width. This machine will handle not only straight cutting, but also in or out curves having a minimum

radius only slightly larger than the diameter of the blades. The spiral steel frame carries all gearing and is mounted on a substantial cast iron base. All gears have teeth cut from solid metal and are provided with cast iron gear guards, so the workman is fully protected while operating the machine. The blades, which are made of high-grade tool steel, are set in approximately a horizontal plane. This gives a very large cutter bearing on the sheet or plate and, consequently, there is very little distortion in the cutting. The upper cutter is positively driven, while the lower cutter is mounted in an adjustable sleeve, so that its position may be varied to allow for different thicknesses of material and for redressing. In addition to this, a cam is provided so that the lower blade can be dropped enough to permit the removal of sheets without reversing the machine. The cutters have a flush fastening to the shaft, so that no nut projects to interfere with the handling of the work and the knurled edges feed the sheet automatically into the machine. A tool steel pin is provided to take up the end thrust on the lower cutter shaft. Where a number of sheets are to be cut to the same pattern, a template may be bolted to the work, and this template followed by guiding against the top cutter.

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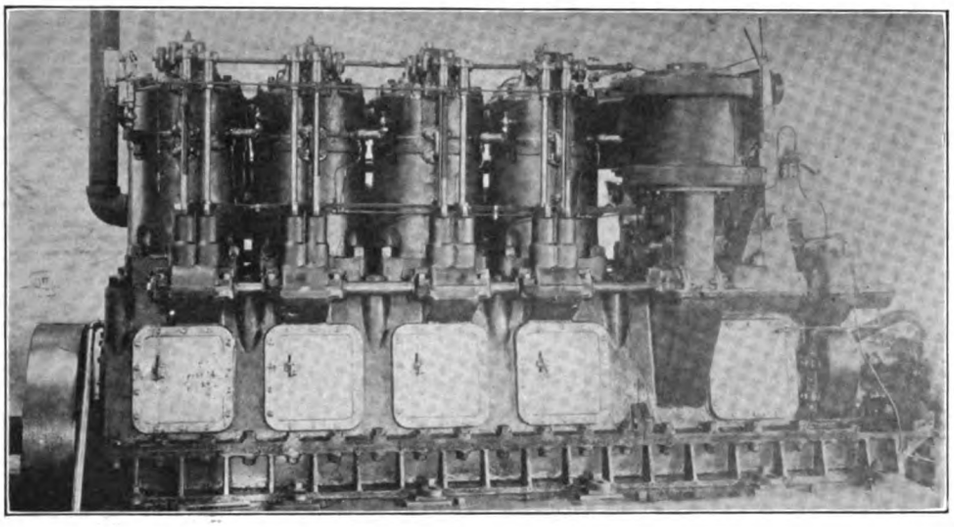
The machine is driven by means of a two-speed pulley, giving slow speed for intricate curve cutting and high speed for straight work. The main drive shaft is extended and squared on one end, so that a hand crank may be used if power is not available. This shear, it is claimed, will reduce cutting costs fully one-half by replacing old-style hand and power cutters, and thus saving time and labor in handling. The shear illustrated has a capacity for cutting No. 10 gage material and lighter, while other sizes having capacities of No. 16 gage ¼-inch and ⅜-inch material can be furnished. All machines are arranged for either belt and hand power or direct motor drive.

"Speedway" Fuel Oil Engine of the Diesel Type

The "Speedway" oil engine, just brought out by the Gas Engine and Power Company and Charles L. Seabury & Co., Consolidated, Morris Heights, N. Y., and exhibited for the first time at the New York Motor Boat Show in February, is of the two-cycle reversible type with valve scavenging. The size being built at present has four cylinders, 9-inch bore by 12-inch stroke. The scavenge air is furnished by a single cylinder operated by a crank on the after end of the crank shaft. The scavenge cylinder has a bore of 18½ inches by 10 inches stroke and works double acting, delivering air to a manifold running the length of the engine. The engine is of the closed type with cast iron frame and bedplate, both of which are strongly ribbed and secured together by means of long steel tie rods between the cylinders. The frame has large hand holes in both sides for easy access to the bearings. The crankshaft bearings in the bedplate are bronze babbitted, with removable shells. The cylinders are cast with integral water jackets of large capacity and central exhaust openings, also jacketed. The cylinder heads are separate and secured to the cylinders by means of light steel studs.



Each cylinder head contains two scavenge valves, one fuel valve, one air-starting valve and a relief valve. The cam shaft has its bearings in the frame and is driven from the crank shaft by means of spur gears. The fuel and scavenge valves are operated from the cam shaft by means of push rods and levers held in brackets on the cylinder cover. On the opposite side of the engine from the cam shaft is another shaft running the length of the engine, which carries cams for operating the air-starting valves. On this shaft are carried two sets of cams with tapered approaches. This shaft is operated by means of a hand lever, which, by pushing ahead, brings the ahead cams into action, giving the engine a start ahead. The other position of this lever in like manner brings the other set of cams into action, starting the engine astern. The fuel is pumped to the spray nozzles by means of a separate pump for each cylinder. The suction valves of the fuel pump are controlled by means of a lever so that they can be held open for a longer or shorter period, thus controlling the amount of oil pumped to the cylinders. The cam shaft is driven through a spiral sleeve, by which means the engine can be reversed by shifting a lever operating to rotate the cam shaft through an angle of 30 degrees. The scavenge cylinder has a piston valve, which eliminates the clatter of automatic valves. This piston valve is driven from the cam shaft and is also shifted by the reverse lever. The pistons are of the trunk type, extremely long, having dished heads. Each is fitted with eight spring rings.

All parts of the engine are designed to allow accessibility for the removal of parts. The spray nozzles are of steel and can be very readily removed for examination and replaced without disturbing adjustments. All valves in the cylinder head are easily removed independently. It is also a comparatively simple matter to remove a cylinder head.

Lubrication for the main bearings, crank pins and wrist pins is by means of a pressure system, the oil being forced through holes in the crank shaft by means of a pump driven from the after end of the crank shaft. Lubrication for cylinders and air compressors is supplied by means of a forced feed manifold oiler. The flywheel is carried on the forward end of the crank shaft, keyed to the tapered end. On the after end of the crank shaft is fitted, in an oiltight compartment, a roller thrust bearing of large size. The thrust compartment is so arranged that the entire thrust can be readily removed for examination without disturbing other parts of the engine. A two-stage compressor is driven by means of links and levers from the scavenge pump crosshead. This pump keeps the spray air bottle charged to 1,000 pounds, excess air escaping into air-starting bottles which are kept charged to 750 pounds pressure. A butterfly valve is fitted in the suction of the first stage compressor, so as to regulate the amount of high-pressure air. A double air cooler is attached to the engine frame just forward of the high-pressure compressor to cool the outer air from the two stages; the circulating water passes through this cooler first, so that the maximum amount of cooling is obtained.

The engine is operated entirely from the after end, where all controls are located, together with the gage board and forced feed lubricator. The control levers are four in number, consisting of the main reverse lever, the air-starting lever, the throttle lever controlling the oil and the spray air lever controlling the air pressure by means of a reducing valve. By

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having separate control levers a very simple gear is obtained, which is easy to handle and can be kept in working order.

The operation of starting consists in placing the main reverse lever either ahead or astern, then placing the throttle and spray air levers in starting positions, and finally by means of the air starting lever giving the engine a start in the direction corresponding to the setting of the reverse lever, all of these operations taking much less time in their actual performance than it takes for the telling.

The engine develops 175 horsepower at 350 revolutions, and may safely be run at 400 revolutions per minute. The weight complete is 16,500 pounds.

SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

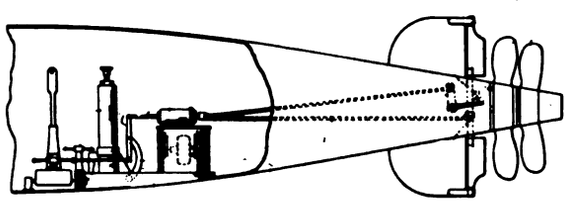
American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millertown, N. Y.

1,079,208. APPARATUS FOR CLEANING THE HULLS OF SHIPS OR ANY KIND OF VESSEL. FREDERICK GEORGE BROWNE OF MALVERN, NEAR MELBOURNE, VICTORIA, AUSTRALIA.

Claim 2.—An apparatus for cleaning the hulls of vessels, comprising in combination, a support floated beside the vessel to be cleaned, a member pivotally carried by said floated support and extending derrick-wise between said support and the hull of the vessel to be cleaned, whereby its head may be adjusted at varying heights in contact with the hull to be cleaned, a cleaning device suspended by a plurality of points from the head of said pivotally carried member so that it is thrown into contact with the hull when said member is positioned to space the support from the hull, means to draw said support toward the hull to hold the head of said pivoted member in contact therewith and rigidly brace said support, and means for varying the relative angular positions of the points of suspension of the cleaning device whereby to utilize the weight thereof to adjustably create a pressure of the cleaning device against the hull. Three claims.

1,080,116. STEERING MECHANISM FOR AUTOMOBILE TORPEDOES. FRANK M. LEAVITT, OF SMITHTOWN, NEW YORK, ASSIGNOR TO E. W. BLISS COMPANY, OF BROOKLYN, NEW YORK, A CORPORATION OF WEST VIRGINIA.

Claim 1.—In a torpedo, the combination with the hull and lateral and depth steering means, of steering mechanisms for such respective means,



and a single support for both such mechanisms, removable at will from the hull. Fourteen claims.

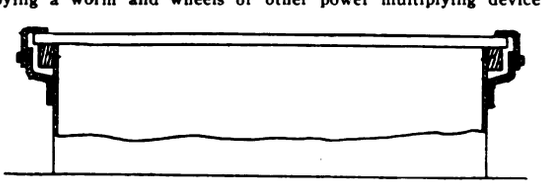
1,080,876. LIFE-BOAT. ANDREAS B. ANDREASSEN, OF BROOKLYN, NEW YORK.

Claim 1.—A boat having a hull provided with transverse bottom compartments for water ballast, a pipe passing through one of the compartments and opening through the sides of the hull below the water line, a pipe connected to said pipe, a valve for shutting off and establishing communication between said pipes, the second-mentioned pipe having branches extending respectively into the transverse compartments, a valve in each of said branches, and a pump having its inlet connected to the second-mentioned pipe. Two claims.

British patents compiled by G. E. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

23,449/1912. IMPROVEMENTS IN HATCH COVERS AND COAMINGS FOR VESSELS. E. F. GLOVER, THOMAS LYON AND J. NEVILL, ALL OF 11 REDCROSS STREET, LIVERPOOL.

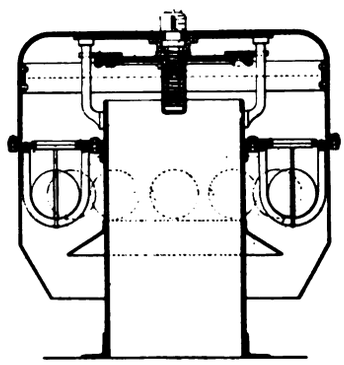
An improvement on Weir's Patent, No. 26,756 of 1909, consists in employing a worm and wheels or other power multiplying device that



will stand locked in any position for winding off and on the cover. A smooth bar or angle plate such as shown is fixed at the inside or outside of the hatch frame, with its upper surface a trifle above or level with the hatch on which the cover can run with little friction, and a molding is hinged and hooked over the cover, or formed in two or more pieces, as shown, to overlap the cover at the edges and prevent water from entering the hatchway. A ratchet and pawl is provided for automatically preventing the roller from being worked in the reverse direction.

8,618/1913. IMPROVEMENTS IN SHIPS' VENTILATORS. J. BROADFOOT & SONS, LTD., OF INCHHOLM WORKS, JAMES STREET, WHITEINCH, GLASGOW.

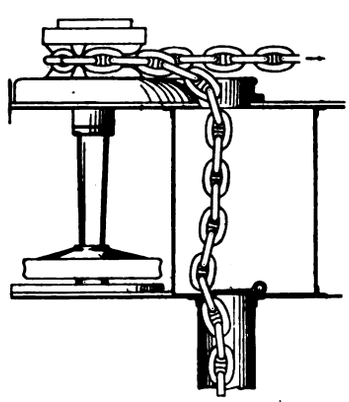
Claim.—A ship's ventilator having a stationary hood depending over the upstanding end of a ventilating trunk is provided with a horizontal



apertured diaphragm extending between and making a tight joint with hood and trunk. Valve seats surround the apertures in the diaphragm and a series of buoyant balls act as valves coacting with the valve seats, cages holding the balls beneath the seats. A disk valve is arranged to engage and make joint with the horizontal top of the ventilating trunk, the valve being operated by a screwed spindle projecting through the hood and being provided externally to it with means for its operation. The disk valve is prevented from rotating when acted on by the screwed spindle. One claim.

12,128/1913. IMPROVEMENTS IN THE DROPPING OF ANCHORS. C. D. B. HANSEN, OF 88 BERKELEY STREET, GLASGOW.

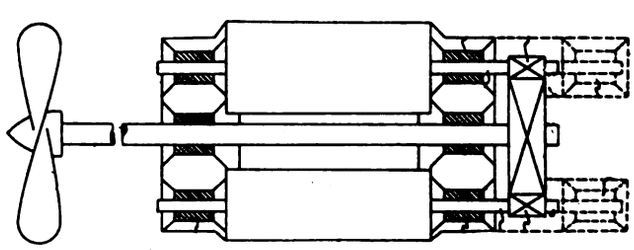
Claim.—An auxiliary locker is arranged immediately under the windlass deck and in communication with the main locker in the ship's bottom and provided with an opening or aperture in its floor, which



opening is closed with a cover or lid operated by quadrantal rack and pinion, or by block and tackle, and so fitted that when all the cable has run out of the auxiliary locker the lid is made to open automatically and allow the cable in the main locker to run out freely without construction. One claim.

14,832/1913. IMPROVEMENTS RELATING TO GEARED PROPELLER SHAFTS FOR SHIP PROPULSION. G. & J. WEIR, LTD., AND J. G. WEIR, OF HOLM FOUNDRY, CATHCART, GLASGOW.

Comprises an arrangement of mechanical gearing for the driving of the propeller shafts of ships in which the propeller shaft is extended



forward alongside the prime mover or movers, the gearing being located forward of the prime mover or movers, and the propeller shaft and driving shaft or shafts provided with bearings rigidly connected together and at the forward end of the prime mover or movers and adjacent to the gearing, and also with bearings rigidly connected together and at the aft end of the prime mover or movers.

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